THE EFFECTS OF INTERACTIVE (TIPS) HOMEWORK ON FAMILY INVOLVEMENT AND SCIENCE ACHIEVEMENT OF MIDDLE GRADE STUDENTS

By

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For Kerry, Carolyn, & Ken

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Abstract of Dissertation Presented to the Graduate School
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The purpose of the study was to investigate the effects of interactive and non-interactive science homework assignments on family involvement in homework, homework completion and accuracy, student science achievement, and student and parent attitudes about science. Most previous research on homework has examined what parental involvement results naturally, without prompts or instruction from teachers. In contrast, this study experimentally examined the effects of teacher prompts to parents for involvement in their children's homework. Two hundred and fifty-three students from 10 classes of sixth and eighth grade students participated in the study that lasted 18 weeks of the school year. Six classes of students completed the TIPS (Teachers Involve Parents In Schoolwork) interactive homework assignments, and four classes completed the non-interactive assignments that contained the same content and questions as the TIPS assignments. The TIPS students received instructions to involve a parent or other family partner in certain sections of the homework assignment. The ATIPS students received the same assignment with no instruction to involve another person. Results indicated that TIPS students more often involved parents in their science homework assignments than did ATIPS students. However, TIPS science students reported no more parental involvement in homework than ATIPS students in subjects where teachers did not assign interactive homework. Therefore, the TIPS instructions elicited more parental involvement in homework than the ATIPS assignments. The TIPS students did not differ from ATIPS students in accuracy or the percent of homework returned. Students who rated the homework more positively and who regularly involved their families returned more homework assignments than students who did not do so. The TIPS students did earn significantly higher science report card grades than ATIPS students after controlling for background variables, teacher effects, and percent of homework returned. Exploratory analyses of matched student and parent data suggest the importance of both student and parent data in research of interactive homework. The results of the study indicate the benefits of well-designed interactive homework for levels of family involvement, science attitudes, and science achievement.

CHAPTER 1
INTRODUCTION

Education reform in the elementary and secondary grades constantly weighs on the minds of families, educators, business people, community members, and politicians in the United States. Researchers, educators, and politicians worldwide have proposed numerous strategies to improve current educational practices: reduction of class size, better preservice teacher training, end of social promotion, standards-based reform, voucher programs, and increased and informed family involvement in children's education.

For solutions to current educational shortcomings, one must consider the goal of the efforts or changes. Though the specifics of the goals differ, most people would probably agree that yesterday's, today's, and the future's main concern is to better educate our *children* to survive in this increasingly "informational" age. Children remain at the center of the issue and are influenced not only by their school environments, but also by their family and community environments (Epstein, 1992).

Therefore, any solution affecting change only in the school environment (like standards-based reform or reduction of class size) may result in improvements but will probably fail to completely address the current multidimensional educational issues (Coleman et al., 1966). Problems in education are complicated. Schools vary in teaching philosophies and standards; represent children of various developmental levels, backgrounds, and cultures living in varied communities; and identify similar and different challenges. Part of the solution to today's educational concerns must recognize these intricacies and include inter-environmental strategies like family involvement or school-family-community partnerships.

Many research findings indicate the positive impact that parental involvement may have on student development and academic achievement (Booth & Dunn, 1996; Chen & Stevenson, 1989; Dornbusch, Ritter, Roberts, & Fraleigh, 1987; Eccles & Harold, 1996; Epstein, 1988; Epstein, Simon, & Salinas, 1997; Fehrmann, Keith, & Reimers, 1987; Ho Sui-Chu & Willms, 1996; Keith et al., 1993). Most parents recognize the importance of involvement in their children's education. Students desire positive interactions with their parents, guardians, or family members regarding their educational endeavors, and teachers want students to communicate with their families about school subject matter. Despite interest from students, teachers, and parents themselves in parental involvement in a student's academic progress, parents still continually seek direction by asking, "How may I help my child with her education at home?" (Epstein, 1998).

Though all involved parties seem to desire connections between home and school, it takes a concerted and coordinated effort on the part of teachers, families, school administrators, researchers, and policymakers to make these partnerships a permanent foundation of our educational institutions. Since the publication of A Nation At Risk (National Commission on Excellence, 1984), researchers and policymakers have presented parental involvement as one possible and promising strategy to improve education. Such policy efforts have continued with the passing of Goals 2000: Educate America Act that includes a call for "partnerships that will increase parental involvement and participation in promoting the social, emotional, and academic growth of children." (National Education Goals Report, 1994, p. 11). The media also have directed attention to parental involvement through articles like "How to make your kid a better student: Yes, parents matter. Here's how." (Willis, 1998).

The present study focused on a specific form of parental involvement in student education, namely parental or family involvement in student homework. Though homework is an accepted and expected part of school life, it has long been a controversial part of the education process, and debate has been renewed of late as evidenced by a flurry of recent media attention. Writers frame the concerns of many educators and families in titles including "The homework ate my family. Kids are dazed. Parents are stressed." and "Homework bound: Schools are assigning more and more to younger and younger children. First grader? No excuse! A hundred years later, the homework wars rage on." (Ratnesar, 1999; Winnerip, 1999). Can teachers, students, and parents do more to add value to the homework process and quell some of the quarreling? Research in the areas of homework and parental involvement can help to inform this debate.

Theoretical Background

Both homework and parental (family) involvement in education link two environments that influence the development of children: the family and the school. Epstein proposed a theoretical model to describe family-school connections (1987) and described four possible relationships between families and schools that reflect paradigm shifts in the way that people have perceived the needs of families, schools, and children: separate, sequenced, embedded, and shared (1992).

Separate responsibilities refer to unshared goals of schools and families and their separate contributions to society (Waller, 1932; Weber; 1947). This perspective stresses the independent functions of families and schools and therefore represents rare communications between the two unless students experience problems in school or at home.

Sequenced responsibilities build on the theme of separate responsibilities but recognize a progression of influence. This perspective emphasizes a sequence of critical stages beginning with parents first contributing to their children's education in preparation for school. Once children are school age, educators take over primary responsibility for educating children. Both separate and sequenced responsibilities of families and schools have been questioned as true representations of today's school-family relationships as many mothers enter the workforce, use child care early in the lives of their children, and have more education to know how to promote the positive development of their children.

Embedded relationships refer to nested connections between individuals and larger groups and organizations. This represents an ecological model in which individuals are embedded within systems or layers (concentric circles), with those closest to the child having the most direct impact and those farther away having a less direct effect on development (Bronfenbrenner, 1986). Embedded relationships emphasize the importance of social factors and contexts and how these affect children's cognitive development (Markus & Kitayama, 1991; Miller, 1993; Wetsch & Tulviste, 1992). Unlike the separate and sequenced perspectives, the embedded perspective does recognize the effects of multiple environments like the family, school, neighborhood, media, and community on the child. However, the embedded perspective fails to address questions about developmental change or longitudinal effects of multiple environments (Epstein, 1992).

Overlapping responsibilities refer to dynamic relationships between schools and families that can be pushed together or pulled apart by practices and interpersonal forces. Pictorially, the school and family each may be represented by spheres that overlap in specific areas, not embedded within each other. This model of overlapping spheres of influence does not presuppose that all responsibilities of families and schools overlap, but it does assume that there are some shared goals for students between the two institutions during most of a child's development. In addition to linking family and school, the model is developmental in that it affords changes in degree of overlap with student age and grade level (Epstein, 1987, 1995).

Two levels of interactions may occur within this model: institutional (external) and interpersonal (internal). The external structure of the model includes the two spheres representing the school and family that are affected by three forces: time or development of the child, experience or philosophy of the family, and experience or philosophy of the school.

The internal structure of the model emphasizes the interpersonal relationships, within or between organizations. There are also two levels of interaction: 1) standard, organizational communications such as information to all parents about school policies, and 2) specific, individual communications that occur between parents and teachers of an individual child (Epstein, 1987). Therefore, the model accounts for the histories of the major institutions and the dynamic nature of the changing skills of individual (Epstein, 1992).

The child is at the center of the areas of overlap between schools and families (and communities, Epstein, 1995). "Children interact with, influence, and are influenced by their schools, especially their teachers; and by their families, especially their parents," and by changes in school, teacher, and family practices (Epstein, 1987, p. 130). The theory permits various research questions about the institutional and individual connections that ameliorate student learning.

Because the present study was grounded in psychology and the individual level of analysis, its focus featured the internal structure of the overlapping spheres model. Therefore, information about the historical context of family-school relationships or about the impact of political, economic, and social events on these relationships was not analyzed in the study. The purpose of this study was to investigate how interactive and non-interactive science homework affect family involvement in homework and science attitudes and achievement of middle grade students as well as the attitudes and behaviors of their family members or other homework partners.

Focus of the Literature Review

The literature review that follows first describes the different relationships between parental involvement and student academic achievement. Next is a presentation of findings related to homework and student academic achievement and attitudes. The final section demonstrates how parental or family involvement and homework findings may be integrated to create interactive homework that is designed to increase communication between the home and the school (Epstein, in press; Epstein, Salinas, & Jackson, 1995). Though these topics cross many disciplines, this review focuses on research from the areas of psychology, sociology, and education.

Parental Involvement

Parental involvement is a broad term or construct like "aggression" or "altruism" that means different things to different people. Therefore, researchers have constructed varying definitions of parental involvement depending on the measures and outcomes they use (Epstein, 1992; Georgiou, 1997; Greenwood & Hickman, 1991; Grolnick, Benjet, Kurowski, & Apostoleris, 1997; Grolnick & Slowiaczek, 1994; Hoover-Dempsey & Sandler, 1997; Ho Sui-Chu, & Willms, 1996; Keith et al., 1993; Mannan & Blackwell, 1992; Meighan, 1989, Stevenson & Baker, 1987).

Early studies of parental involvement often utilized one measure to explain the construct such as attendance at school events (e.g., Stevenson & Baker, 1987). More recent work addressing parental involvement involves multidimensional conceptions including both home- and school-based activities related to children's learning (Epstein, 1995; Grolnick and colleagues, 1997; Keith and colleagues, 1993). For example, Keith and colleagues (1993) include parental educational aspirations for the child, parent-child communication, amount of home structure, and parent participation in school activities as measures of parental involvement. Hoover-Dempsey and colleagues (1992) collected the following data to gauge parental involvement: parental help with homework, parental participation in other educational activities, parent volunteer work at school, telephone calls with teachers, and parent-teacher conferences.

Most researchers separate parental involvement from parental beliefs. Involvement is defined as home- and school-based observable activities related to children's learning at school (Hoover-Dempsey & Sandler, 1997). Parental beliefs, which certainly affect decisions to become involved, refer to the cognitive, non-observable processes behind the actions of parental involvement (Miller, 1988).

Researchers often study parental involvement within a particular domain and in so doing use the term parental involvement in conjunction with a modifier, a specific task or area. For example, the proposed study focused on parental or family involvement in middle grade students' interactive science homework assignments. This represents one of six types of involvement among schools, families, and the community outlined by Epstein (1992, 1995). The six types include the following: parenting (basic responsibilities of parents), communicating (two-way communication between school and home and home to school), volunteering, learning at home, decision-making (parent representation on school decision-making bodies), and collaborating with the community. Parental involvement in homework of course relates to Type 4: Learning at Home.

Developmental differences in parental involvement levels

Despite differences in definitions of parental involvement, many researchers have found that parental involvement in schooling (however it is defined) tends to decline as children grow up (Cooper, 1989, 1999; Eccles & Harold, 1996; Epstein, 1988, 1998; Stevenson & Baker, 1987). Stevenson and Baker (1987) found a negative relationship between age of child and level of parental involvement in schooling. Parents tended to be more involved when their children were young, but involvement declined as time passed. Those mothers with higher educational status tended to be more involved in their children's school activities. Most important, children of involved parents performed better in school than children of parents who were less involved in their schooling activities. While the reasons for decline in parental involvement have not been proven, many hypotheses have surfaced.

Factors affecting the involvement decision

Hoover-Dempsey and Sandler (1997) proposed a model that frames many of the explanations of decreased involvement levels with age, emphasizing three variables that particularly affect parental involvement decisions: parental role construction, parental efficacy, and level of invitations and demands from children and the school.

Parental role construction refers to parental beliefs or expectations of their role in their children's educational progress. These expectations are absorbed by parents from their own culture, including family, church, educational background, and other forces providing guidance in the rearing of children. Therefore, many researchers believe that the way parents construct their roles directly relates to their actions or involvement behaviors. For example, Sheldon (1999) examined the relationship between parental (mothers only) role construction and parental involvement behaviors using Likert scale surveys with questions like the following: "It is a parent's responsibility to help her child understand his or her homework." Results revealed that parental role construction significantly correlated with and predicted mother's involvement behaviors both in and out of school.

Parental efficacy, another type of parental belief, signifies the degree to which a parent thinks he may effectively help his child with the skills he has available (Hoover-Dempsey & Sandler, 1995, 1997). Studies have indicated a positive relationship between parental education (SES) and parental involvement in student education, namely the fact that more educated parents tend to be more involved in their children's education (Ames, De Stefano, Watkins, & Sheldon, 1995; Astone & McLanahan, 1991; Lareau, 1989; Sheldon, 1999; White, 1982). Lack of education also may relate to a parent's sense of efficacy such that less educated parents often feel less efficacious than more educated parents in their efforts to help their children with academic tasks, especially as children grow up (Hoover-Dempsey et al., 1992). Sheldon (1999) also assessed the relationship between parental efficacy and parental involvement at school and at home. Like parental role construction, self-efficacy significantly correlated with parental involvement at home. However, the relationship was not as strong as the relationship between parental role construction and parental involvement. Self-efficacy correlated (though not significantly) with parental involvement at school. Therefore, both parental self-efficacy and parental role construction are types of beliefs that represent important variables to consider in studies of antecedents to parental involvement at home.

General invitations and demands relate to requests from the school and the child for the parent to take part in educational activities with the child. As highlighted by Epstein, most studies fail to address the school's role in encouraging parental involvement in student education (Dauber & Epstein, 1993; Epstein, 1991; Epstein & Dauber, 1991). Epstein and Dauber (1991) investigated ways in which 171 teachers in inner-city elementary and middle schools attempted to involve parents. Their findings pointed to another reason besides parental role construction and parental efficacy as to why parental involvement decreases between the elementary and middle grades. They found that teachers in the middle grades provide fewer opportunities for parental involvement than do their elementary grade counterparts. Extending this study, the researchers then investigated the reports of parents on their perceptions of invitations/ requests for parental involvement. Regardless of parent education levels, they found that parents are more likely to be involved if they perceive the school to be actively working on involving them in their children's education.

A study by Ames, Khoju, and Watkins (1993) supports these results and included an investigation of the way that teacher communication practices affect parental involvement. Their findings indicated that when teacher communications to the home include information that supports parental efficacy, parent comfort with the school increases. This in turn influences parental perceptions of the child as learner. When these effects result, parent involvement may increase.

In summary, early studies of parental involvement pointed to fixed characteristics of parents (such as parent education and socioeconomic status) as most directly related to parental involvement levels and student achievement outcomes. However, investigators now highlight modifiable variables (variables that may change as a result of information, guidance, and/or invitations) like parental role construction, parental efficacy, and especially general invitations from the school as more helpful ways to increase parental involvement between the elementary and middle grades.

Factors affecting parents' choice of involvement

The review above included a summary of three main factors influencing parents' decisions to be involved in their children's education. Hoover-Dempsey and Sandler (1995) delineate a second level of three additional factors influencing the specific forms of involvement parents choose: specific domains of skill and knowledge, the mix of employment and other family demands, and specific invitations and demands from the child and school.

Parents choose involvement forms that use their specific skills. For example, parents with strengths in math are likely to help with math studies. Those who feel comfortable leading decision-making may volunteer to head the PTO but may choose not to help out in the school office with copying or typing. The form of involvement also relates to the demands on a parent's time--such as employment, childcare, or other family responsibilities (Lareau, 1989). Finally, invitations from the child and the school will affect how the parent chooses among involvement alternatives (Hoover-Dempsey & Sandler, 1995).

In sum, these three factors (specific domains of skill and knowledge, the mix of employment and other family demands, and specific invitations and demands from the child and school) further elucidate the specific forms of involvement parents choose. They do not, however, negate parents' initial decisions about whether to be involved or not. If parents place a high premium on involvement based on their views of parental role construction, self-efficacy, and general invitations, they will find a way to be involved regardless of their specific skills, demands on time, and general invitations (Hoover-Dempsey & Sandler, 1995).

Homework

Homework has been defined as "tasks assigned to students by school teachers that are meant to be carried out during non-school hours" (Cooper, 1989, p. 7). Because it is most effective in promoting student achievement when it is completed during non-school hours (Keith, 1998), homework (as suggested by its name) is often worked on in the home and may serve as an important link and form of communication between the school and the home (Corno, 2000; Epstein, 1995).

Both the school and settings outside the school may contribute positive and negative characteristics to the student homework experience (Corno, 2000). For example, teachers who design homework that balances challenge and skill may encourage classes of students to value the importance of the homework experience, promote student achievement, and encourage positive attitudes toward particular school subject areas. In contrast, if homework is too challenging, too easy, non-varied, or too frequent, classes of students complain and fail to see the benefits of the homework experience. Similarly, family members, peers, and community members may add value to homework by offering judicious assistance and new perspectives to homework questions. On the more negative side, these influences from outside the school may distract the student from completing homework.

A brief look at history demonstrates shifting public opinion over the homework topic (Cooper, 1989, 1998; Winnerip, 1999). During the 1800s, teachers emphasized the importance of memorization as a key homework strategy. Educators saw memorization as an excellent mental exercise vital to new knowledge acquisition, and suitable for work at home. By the early 1890s, people began voicing concerns over constant recitation, and the first anti-homework movement began with charges that homework impedes children's physical and mental health. By the 1920s, some school districts even abolished homework arguing that constant drill activities often discourage student interest in learning and interfere with home life. Attitudes again shifted in favor of homework during the 1950s with "progressive" educators calling for more creative homework assignments. The success of Sputnik in 1957 launched an era of global competition wherein homework was used as a means to complete with the Soviets in math and science. In the 1980s, the United States began to view the disciplined and industrious people of Japan as its new world competitor, sparking a call for intensified homework as a means to compete. This brings us to the end of the century with an awareness that homework is here to stay as an everyday part of school life.

Historical attitudes have portrayed the topic of homework as an "all-or-none" debate, with some proposing a need for more homework and others arguing for none. Though researchers now focus on more complex issues, the first studies of homework focused on whether or not students benefit scholastically from completing homework. Early studies compared students completing homework to those not completing homework. Meta-analyses indicate that completion of homework does have a positive effect on student achievement as measured by class grades or achievement test scores (Cooper, 1989; Paschal, Weinstein, & Walberg, 1984).

Developmental differences

Though completion of homework positively relates to student achievement, the age of the student moderates the relationship. Achievement scores of high school students more positively relate to homework completion than do those of elementary students. In a meta-analysis of studies conducted before 1989, Cooper found that high school students completing homework outperformed 75% of students in a no-homework class. Junior high students outperform about 40% of students not assigned homework; and homework assignments in the elementary years had small effects on student achievement gains (1989, 1998). Though completion of homework in the elementary grades is not strongly related to student achievement, the practice of homework, when it helps young children develop good study habits, has a long-term positive effect on secondary school achievement (Cooper, 1998) and student understanding of responsibility, and an immediate effect on the mastery of skills.

With the discovery that completion of homework often correlates with increased achievement, researchers then began to investigate how much time investment was needed to achieve benefit (Cooper, 1989; Keith, 1982; Keith & Cool, 1992; Paschal, Weinstein, & Walberg, 1984; Walberg, Fraser, & Welch, 1986). Again, age of student moderated these correlational relationships. In the elementary grades, many studies show that increasing time spent on homework correlates with lower school grades and achievement, a negative relationship. In contrast, by the middle grades and high school, this relationship becomes positive such that more time spent on homework relates to higher grades and achievement. In fact, Keith's (1982) results indicate that a low-ability high school student completing one to three hours of homework weekly could theoretically achieve grades commensurate with an average student who fails to complete homework (p. 251).

However, these correlational relationships fail to tell us what causes the relationship between time on homework and achievement to be negative in the elementary grades and to be positive in the high school grades. Epstein (1988, 1998) offered several plausible explanations. First, elementary students often are assigned the same type of homework activity night after night. These activities often take the brighter students less time to finish; therefore, the brighter students earning higher grades spend less time on homework, a negative correlation. In addition, Epstein has found that there is also a strong negative relationship between minutes of parent help and achievement in the elementary grades. Therefore, it seems that slower students and their parents work together in the elementary years on the mastery of skills. We do not know what happens during the middle and high school years, but Epstein (1998) suggested the following possibilities: teachers may stop giving low-achieving students homework; parents may stop monitoring their children's homework; or low-achieving students may stop completing assigned homework. Muhlenbruck and colleagues (2000) conducted a study to address this developmental relationship and found weak evidence that young students who were struggling took more time to complete homework.

Age also plays an important role in students' understanding of the responsibility to complete homework. For example, Warton (1997) investigated second, fourth, and sixth grade Australian children's understanding of responsibility for homework. Though all children provided a reason for completing homework, there were developmental differences in terms of children's understanding of responsibility. Sixth grade children provided responses like the following: "It's your work, not your Mum or Dad's"; while second grade children responded "It would be a favor to Mum if I remembered (to do my homework)." Whereas older children understand and can articulate the fact that homework is their responsibility to initiate and complete, younger children often have not yet integrated this understanding that it is their job to remember their homework assignments, not their parents'.

Parental involvement in homework

Parents contribute in various ways to their children's education. Scott-Jones (1995) proposed a four-level framework to organize the different types of parent-child interactions that affect school achievement: valuing, monitoring, helping, and doing. Valuing refers to the fact that parents communicate the importance of education to their children. Like valuing, monitoring affects student motivation and relates to parental supervision of children's academic performance. Helping interactions involve working together on basic skills. Doing interactions exemplifies an overly-involved parent who disregards a student's need for autonomy and does homework for his child. Therefore, this framework highlights both positive and negative forms of parental involvement that emerge in home-based parental help.

Negative findings. Several researchers have investigated the role of parental involvement in the homework process (Cooper 1998, in press; Epstein, 1988, 1991; Epstein & Lee, 1995; Epstein et al., 1997; Hoover-Dempsey et al., 1992; Hoover-Dempsey, Bassler, & Burrow, 1995; Leone & Richards, 1989; Levin, 1997; MacBeath, 1998; McDermott, Goldman, & Varenne, 1984; Moller 1994; Xu & Corno, 1998). For example, Cooper (in press) conducted an investigation of 709 parents (from grades 2, 4, 6, 7, 8, 10, 11, and 12) regarding involvement in their children's homework. He found that two-thirds of the parents reported providing a form of help that was negative or inappropriate such as helping the child in order to finish more quickly, helping the student despite knowing that the work needed to be completed independently, or helping the child and knowing that the help made the work harder for the student. Although we often assume benefit for students through parental involvement, it can be counterproductive if parents are not given explicit instruction from teachers on how best to be involved in the homework process.

Several studies highlight this need for improved communication between school and home regarding parental help with homework (Balli, 1998; Dauber & Epstein, 1993; Epstein, 1991; Epstein & Dauber 1991; Epstein & Lee, 1995; Hoover-Dempsey et al., 1995; Hoover-Dempsey & Sandler, 1997; Lehrer, 1997; Scott-Jones, 1995; Xu & Corno, 1998). According to Hoover-Dempsey and colleagues (1995), most parents of elementary students felt it was their duty to help their children with homework, but many felt unprepared to help with certain subjects. Some parents openly discussed embarrassment regarding their lack of skills to help or discussed frustration with spending most of their time trying to communicate ideas using vocabulary that, according to the children, differs from the teacher's.

Xu and Corno (1998) conducted a case study investigation of a small group of well-educated families involved in their children's third-grade homework. Even this small and educated sample of families spent much of their time trying to improve and make their children's homework assignments more interesting. Though this involvement may be positive for these families, one must consider what happens to the children of parents who do not have the skills or time to improve existing homework and to inspire the interest of their children.

Negative forms of family involvement are not limited to the elementary grades. Epstein and Lee (1995) studied homework practices of middle grades students as part of a comprehensive investigation of school, family, and community partnerships. Using the National Educational Longitudinal Study of 1988 (NELS: 88), the researchers used data from 1011 middle schools, including reports from teachers and principals related to over 20,000 eighth grade students and their parents. Though 91% of parents in the study reported that they believe homework is valuable, over 50% never, seldom, or infrequently helped their children with homework. The authors suggested that this finding relates to the common practice of teachers in the United States to assign homework requiring independent work on the part of the student and no interaction or discussion with family. Reports of principals supported this explanation with over 75% of them stating that less than half of parents at their respective schools receive regular information from teachers as to how they may help their children with homework. Given this lack of information, it is not surprising that 85% of principals in the study report that less than 50% of parents at their school help their children at home or assist with homework.

Results from these studies emphasize the need for parents to have explicit information on how they may help their children with learning activities like homework. Though nearly all parents and families understand the importance of school practices such as homework, many do not know what forms of involvement may be most helpful to their children at different points in development and often do nothing at all to support the homework process.

Positive findings. Because most schools currently do not provide practices or information to facilitate parental involvement with homework, many findings in the literature are negative or null. However, the following are some examples of positive findings related to family involvement in current school practices. Epstein (1988) found that children in the elementary grades who enjoyed talking about homework and school with their parents tended to be better students. In fact, 80% of parents of middle grade students reported talking with their children about middle school (Epstein & Lee, 1995). Most young adolescents reported that they would interact with their families if homework was designed to encourage family interaction (Connors & Epstein, 1994; Epstein, Jackson, & Salinas, 1994), and studies have shown that adolescents in the middle grades who complete homework with their parents tend to be better students (Leone & Richards, 1989).

Research also shows the benefits of parental-child discussion about school-related topics on homework completion and academic achievement in the middle and high school years (Fehrmann et al., 1987; Ho Sui-Chu & Willms, 1996; Keith et al., 1993; Simon, 2000). Keith and colleagues examined the effects of parental involvement (educational aspiration, parent-child communication, amount of home structure, and participation in school activities) on time spent on homework and achievement of eighth grade students. Parental involvement affected achievement more strongly than socioeconomic status; therefore, parental involvement had a strong effect on achievement independent of family background measures. Similar findings emerged for Fehrmann and colleagues' study of high school seniors in the High School and Beyond (HSB) data set (1987).

Research conducted by Ho Sui-Chu and Willms (1996) also indicated that certain forms of parental involvement are more beneficial to student achievement than others. The researchers examined the effects of four types of parental involvement (home discussion, school communication, home supervision, and school participation) on the math and reading achievement of eighth grade students from the NELS data set. Discussion of school-related activities at home had the strongest effect of all the parent involvement variables on math and reading achievement. In fact, parental involvement reduced the effect of SES on achievement by seven percent.

In summary, homework activities often are tedious and fail to generate creativity; parents do not feel prepared to discuss some homework concepts with their children; and parents and teachers need to know what strategies are appropriate for parental help at home. Parental involvement in general exerts the most positive effects when a child perceives the involvement to be developmentally appropriate and a nice fit with the school's expectations (Eccles et al., 1993; Hoover-Dempsey & Sandler, 1995). For example, if parents develop accurate knowledge of the their children's abilities (Miller, 1995; Stevenson, Lee, Chen, Stigler, Hsu, & Kitamura, 1990), their strategies for involvement will be perceived more positively by students. Similarly, given that both the school and family have standards for parental involvement, the better the agreement between parental involvement activities and the school's expectations for parental involvement, the more appropriate the child will perceive the activities to be (Hoover-Dempsey & Sandler, 1995).

Therefore, though current homework practices often discourage familial interaction on homework assignments, those schools that do encourage, instruct, and expect developmentally-appropriate interaction may provide students, parents, and teachers a promising strategy for increasing beneficial forms of family involvement. Such efforts may also promote interest in particular subjects and more positive student achievement.

Teachers Involve Parents in Schoolwork (TIPS) interactive homework

Based on findings from studies of homework and parental involvement, Epstein and colleagues developed a framework for interactive homework assignments by subject as well as sample activities for students in the elementary and middle grades (Epstein et al., 1995). These assignments include clear objectives for learning, instructions for completion, and explicit instructions to the student for involving family members in certain portions of the assignment. TIPS Interactive homework assignments differ from traditional homework in that they are assigned once a week or twice a month; students are given several days to complete the activity (to permit time to involve family); certain sections of the activity prompt students to involve family members in their completion; and parents provide feedback as to how effective the activity was for them and their children. As with conventional homework, TIPS activities are graded, integrated with the curriculum, and designed to extend student learning beyond the classroom.

The TIPS Interactive homework framework helps schools with the many shortcomings in current homework practices. Use of the research-driven framework helps teachers identify topics in the curriculum that require interaction for better comprehension. Through the assignment, teachers provide instructions to students as to how they may involve family members in certain sections of the assignment. To protect family members from embarrassment for not knowing specific concepts, teachers design interactive questions that parents can answer without detailed knowledge of the subject at hand. This promotes discussion of what is being learned in school without embarrassing family members because they may not know about specific concepts. Also, the assignment includes a section asking the parent to communicate with the teacher about the effectiveness of the assignment. If the student finds the assignment to be too challenging or too easy, the parent and student may provide feedback to the teacher to alter the assignment for future use.

TIPS writing. Researchers have assessed the impact of TIPS Interactive Homework in language arts and math. Epstein and colleagues (1997) conducted a developmental investigation of TIPS- Language Arts Interactive Homework with 683 sixth- and eighth-grade students from inner-city schools. They investigated relationships between TIPS completion, students' writing skills (as measured by scores on three writing samples collected in the fall, winter, and spring), report card grades, and parental attitudes about TIPS.

Results indicated that the number of TIPS assignments completed positively related to language arts report card grades; therefore, the more assignments completed the higher the language arts grade. In addition, parent participation on the TIPS assignments positively influenced overall quality of student's writing skills and also related to parents' overall liking of TIPS. Both teachers and parents reported liking TIPS, and parents noted that TIPS helped inform them of what their children were learning in class. Students varied in their liking of school and TIPS, but they did report understanding how to use TIPS with their family members.

Use of TIPS writing homework assignments promoted positive reactions from both teachers and parents about the process and resulted in positive scholastic outcomes for middle grades students.

TIPS math. Balli (1995, 1998) conducted an experimental investigation of suburban middle school students and their use of TIPS math in three ways. Seventy-four sixth-grade students taught by the same teacher were placed in one of three groups: (1) TIPS activities designed with both family and student prompts for family involvement; (2) TIPS activities without family prompts for family involvement; and (3) conventional math homework with no prompts to the student or family for family involvement.

Family involvement was higher for both TIPS groups than for the conventional math group, and families in these groups reported knowing more about what their children were learning in math class. However, though family involvement for the math TIPS group was higher in math than the other two groups, the TIPS families were not more involved in homework in other subject areas. Findings of this experiment allow one to conclude that the design of TIPS caused more family involvement than the conventional homework design. Despite the fact that all groups experienced achievement gains as measured by a posttest of questions related to information from the homework assignment, no significant differences emerged by group.

Both of these TIPS studies alert researchers to the importance of addressing outcome variables besides achievement, as measured by grades or test scores. Other outcome variables worthy of investigation relate to attitudes and motivation for the subject in which TIPS activities are utilized. Though no achievement differences emerged in the Balli (1995) investigation, continued use of the TIPS activities requiring family involvement, further into the school year, might have resulted in more student interest in and motivation for math than students not involving families. Research does suggest that student motivation and learning as well as classroom perceptions relate to classroom performance and degree of cognitive engagement (Ames & Archer, 1988; Pintrich & DeGroot, 1990). Achievement gains and increased interest or motivation often come hand-in-hand in intervention studies (Epstein, 1997; Paris, Yambor, & Packard, 1998). Therefore, any attempt to measure the results of an intervention should include attitude or motivation measures as well as achievement measures because achievement effects often take more time or more comprehensive interventions to see positive results.

Therefore, TIPS Interactive homework assignments may provide teachers with an important strategy for improving current homework practices that often discourage interaction, promote confusion, and emphasize incessant drilling. Most important, TIPS assignments provide a way for teachers to communicate with and invite families to interact with their children on homework. TIPS interactive assignments relate directly to school objectives for learning, encourage creativity, and provide students the opportunity to initiate and discuss issues with their families that do not require that family members be an expert on the topic of the assignment. Few schools currently utilize the TIPS framework as part of curriculum, and TIPS are not an accepted part of school practices today. However, studies of TIPS use can demonstrate what may result in the future if more schools work to improve their current homework practices in meaningful and research-driven ways.

The Present Study

The current developmental and experimental investigation of TIPS Science homework use in grades 6 and 8 extends current knowledge of TIPS use and effectiveness in six important ways. First, the study involved the examination of a subject area not yet investigated, science. Goal 5 of the National Education Goals focuses on math and science achievement: "By the year 2000, United States students will be first in the world in mathematics and science achievement." Despite this goal, many researchers have alerted us to the fact that current science education often discourages girls from pursuing studies in the physical sciences (Burkam, Lee, & Smerdon, 1997). Students, especially girls, reported that science often feels detached from real-life and desire discussion and experimentation to make it a more meaningful experience. Studies of the NELS data indicated that students learned more in science classes that included active learning experiences like regular laboratory activities where students write up lab reports, perform experiments, and discuss concepts. Activities such as these help students learn more than when they simply watch the teacher perform specific experiments (Burkam et al., 1997). Because the TIPS framework for science includes a "Lab Report or Data Chart" section as well as opportunities for performing experiments and discussing conclusions, these assignments should prove beneficial to student learning. Therefore, integrating the TIPS process into this often homework-neglected subject serves as one possible strategy for furthering current science achievement and motivation levels in the middle grades.

In addition to extending knowledge related to science curriculum, the experimental nature of this design permitted the investigation of the role of interaction on homework completion, science interest, and science achievement. This study included two groups: a TIPS interactive science homework group and a non-interactive group. Half of the students in each grade completed TIPS interactive science assignments as they are designed to be conducted, while the other half completed non-interactive assignments (the same content of the TIPS assignment without prompts to the student to involve family members). Very few investigations of homework have included experimental designs (Balli, 1995; Elawar & Corno, 1985; Miller, Duffy & Zane, 1993), and the findings from this study allow comparisons between the performance of students in the noninteractive homework group and students in the TIPS interactive homework group.

Thirdly, the proposed study informs our current knowledge of developmental and gender differences in student homework practices. Students in this study from grade 6 just completed elementary school, and their experiences are very different from students in grade 8 who are finishing their last year in middle school. Whether or not the age and gender experience differences of students in these two grades relate to differences in the way that TIPS are used or received was an important question that is addressed in the investigation.

Another important contribution of this study was its examination of results with different ability levels of students and different teachers. Balli's experimental investigation involved students of the same ability level and teacher. Though these controls allowed interpretations of effects for similar high ability students with the same teacher, it remains important to understand how the intervention generalizes to different teaching styles and students because teachers often vary in their teaching practices and homework feedback (Elawar & Corno, 1985).

The fifth contribution of the study relates to the various science achievement, family involvement, homework completion, and science attitude measures from parents and students. Having different measures such as these allowed interpretations of not only achievement or intellectual effects, but also of social and attitudinal effects that are also important goals of any educational intervention.

Finally, having both parent and child opinions and reports of various questions permitted analysis of the correspondence of their reports and how this relates to various outcome measures for children. Much of the research on intergeneration agreement makes a point of noting the importance to parents of correspondence between parent and child, but there may be various cases where divergence in parent and child opinions may not cause conflict (Goodnow, 1992). For example, Smetana (1988) studied the opinions of parents and adolescents, finding that differences in opinions often did not result in major problems. She distinguished between "disagreement with conflict" and "disagreement without conflict." Preliminary analyses of these patterns of positive and negative agreement as well as patterns of disagreement were explored to begin to understand how these reports relate to student science achievement and student attitudes.

The six contributions of the present investigation underscore both its research and practical implications. The study examined the effect of inviting and instructing parents to be involved in homework on student science achievement and interest. It also provides information on the development, implementation, and evaluation of interactive homework assignments that may be useful to middle school administrators and teachers in their curriculum decisions related to science homework.

CHAPTER 2
METHODS

Sample

All participants in the study came from one public middle school in Baltimore County in the state of Maryland. The school serves a diverse body of students in grades six, seven, and eight. Fifty-three percent of students in the study were white; 36% were African-American, 5% were multi-racial; and the remaining 6% of students considered themselves Asian-American, Hispanic, or other. Two teachers from sixth grade and two teachers from eighth grade utilized the homework intervention over the course of the first two marking periods (18 weeks) of the 1999-2000 school year. The study included a subsample of these teachers' classes, three classes from each sixth grade teacher and two classes from each eighth grade teacher. Therefore, a total of 253 male and female students participated in the investigation: 143 sixth grade students (mean age = 11.39 years) and 110 eighth grade students (mean age = 13.28 years).

Design

The design of the experimental study was a 2 x 2 between-subjects design with two conditions (TIPS and ATIPS) and two grades (sixth and eighth grades). None of the teachers had two classes of the same ability level students. The purpose of this investigation was to compare the effects of completing TIPS homework assignments to ATIPS homework assignments on the average student, not those students at the extremes in either "gifted and talented" or "inclusion" classes.

At the outset of the study, the author assigned classes to either the TIPS or ATIPS condition keeping class ability level constant across condition but not across teacher. Because each participating teacher contributed both an "average" and "above average" class to the experiment, it was not desired to confound condition with ability level.

As planned, ability level was held constant across condition but not across teacher in the eighth grade sample. Due to experimental error in homework assignment implementation, ability level was not held constant across condition; it was held constant across teachers in the sixth grade. Once the author discovered the error in week 2 of the intervention, she collected data from an additional two classes of low ability sixth grade students in the TIPS condition. At this point in the study, parents had already received letters explaining their roles. The TIPS family letter encouraged families to assist children with their homework assignments when children asked. ATIPS family letters included no information about parents assisting children with homework. Therefore, it proved impossible to change a class from the TIPS condition to the ATIPS condition. If such a change happened, it would have confused both the students and parents in these classes. The only way to compensate in some way for the error was to include two additional sixth grade TIPS classes of low ability students in the study.

One hundred and forty-three students came from sixth grade science classes, and one hundred and ten students came from eighth grade science classes. The classes varied in the ability levels of students, including low-ability, average-ability, and honors classes in sixth grade, and average-ability and honors classes in eighth grade. Six classes completed the Teachers Involve Parents In Schoolwork (TIPS) process of science handouts, and four classes completed ATIPS assignments. Each sixth grade teacher (Teachers A and B) taught one honors and one low ability class using TIPS, and one average class using ATIPS. One eighth grade teacher (Teacher C) taught a TIPS average ability class and an ATIPS honors class, while the other teacher (D) taught a TIPS honors class and an ATIPS average class. See Table 2-1 below for more details on the number of students and the study groups.

Table 2-1. Number of students by condition, ability level, and grade (N = 253)

	TIPS		ATIPS	
Student ability level	Grade 6	Grade 8	Grade 6	Grade 8
Low	36			
Average		23	53	22
Honors	54	33		32
Total	90	56	53	54

Materials

During the summer of 1999, teachers from grades six and eight worked with the author to develop TIPS science homework assignments linking to the school curriculum. Teachers from each grade agreed to develop at least 18 activities, allowing the study period to span two marking periods with one assignment for each week (August 30, 1999-January 25, 2000).

A teacher from sixth grade created a total of 18 TIPS activities so that one TIPS assignment could be assigned each week over the course of the first two 9-week marking periods of the 1999-2000 school year. Two teachers from eighth grade created a total of 40 TIPS activities so that one TIPS assignment could be assigned each week over the course of the entire 1999-2000 school year; though this study involves the analysis of only the first 18 assignments. Appendix A lists the assignment order for each of the sixth and eighth grade teachers. Both sixth grade teachers teach their units of work in the same order: skills and processes, oceanography, and machines. However, due to lack of textbooks, the eighth grade teachers cannot teach their 4 curriculum units of the academic year (ecology, heredity, geology, chemistry) in the same order. Teacher C taught the geology unit during the first 9 weeks followed by the ecology unit during the second 9 weeks, and Teacher D taught the ecology unit followed by the heredity unit. Both eighth grade teachers did, however, teach the ecology unit during one of the marking periods of the study.

Interactive (TIPS) Assignments

All the developed TIPS activities include eight important components: 1) Letter to Parent or Guardian (including a brief description of the activity as well as the due date of the assignment), 2) Objective (s), 3) Materials (common, inexpensive items in most homes that are easily obtainable), 4) Procedure (steps for experimentation or scientific thought about a topic), 5) Lab Report or Data Chart (show work or write complete sentences on the topic under investigation), 6) Conclusions and/or Discussion (conclude/ summarize information and/or guide a discussion to extend information into the "real world"), 7) Home-to-School Communication (allows parents to share comments and observations with teachers), and 8) Parent or Guardian Signature (Epstein, Salinas, & Jackson, 1995). In addition, each TIPS activity linked directly to the Baltimore County curriculum indicators in a meaningful and appropriate way, was doable, interactive, the student's responsibility, easy to read and understand, attractive, and 2 pages (a front and back side of a piece of paper). See Appendix B for a sample eighth grade TIPS activity for the geology unit.

Non-Interactive (ATIPS) Assignments

After the teachers developed the TIPS activities, the author produced a second set of "altered" (ATIPS), non-interactive, activities for the experimental investigation. These activities included the same content in terms of information and questions, yet they included no prompts to the student or family regarding family involvement (with the exception of when safety is a concern). Therefore, these non-interactive assignments do not include any prompts for interaction with the family like (1) the letter to the parent or guardian, (2) the home-to-school communication section, or (3) any questions encouraging students to ask their family members questions. Appendix C displays a sample ATIPS activity. This corresponds to the sample TIPS activity presented in Appendix B.

TIPS/ATIPS Test Questions

In addition to developing the science TIPS homework assignments during the summer, teachers wrote 36 total test questions (2 questions for each of the 18 assignments for the first 2 marking periods). Because the content/information of both the TIPS and ATIPS assignments was identical, teachers used the same test questions for both conditions of the study. See Appendix D for a complete listing of the TIPS/ATIPS test questions utilized in the study.

Student/Family Surveys

Most of the measures needed to assess the effectiveness of TIPS and ATIPS assignments came from the homework assignments themselves. However, surveys of students and families provided additional information to learn more about levels of parental involvement in science and other subject areas for students in both conditions, time spent on homework, and student interest in science and the ATIPS/TIPS science homework assignments. See Appendix E to examine items on the student and family sixth and eighth grade surveys.

Procedure

Letter to Families

The teachers and I wrote a letter appropriate for each study condition to be sent to the home of the student with the first TIPS/ATIPS assignment. Each letter described these new homework assignments to students and parents. The ATIPS group letter described the fact that students would receive weekly science assignments on green paper linked to the science curriculum. There was no mention of family involvement in this letter as these assignments were not designed for such interaction.

Conversely, families of students in the TIPS group received a letter explaining weekly assignments on green paper; however, parents were notified of the importance of family involvement in some sections of the activity. See Appendix F for copies of the letters sent home to student families. As noted in the manual for TIPS use, it was made clear that it is the student's responsibility to involve parents, not the parent's responsibility (Epstein et al., 1995).

Science Assignments

Each teacher assigned one TIPS or ATIPS activity per week over the course of two marking periods for a total of 18 assignments. Teachers assigned the first activity the first week of school, and they continued to assign an activity weekly through the study period ending January 25, 2000. Teachers in both grades chose to assign the TIPS activities on Tuesdays and Wednesdays (with some exceptions for holiday), and they were due the following Tuesday. All teachers graded the assignments on a 10 point scale and tested the content of the assignment as they do any other homework. Prior to distribution of any TIPS homework assignments, teachers made it clear to the students that material from the TIPS/ATIPS assignments would be included on classroom examinations.

Science Assessments

Teachers in the study used the science test questions linked to each TIPS/ATIPS science activity to assess the science achievement of students. Teachers were given flexibility in terms of when these test questions were given, whether on a test or quiz, but all teachers included the relevant test questions on their classroom examinations. Teacher A for sixth grade gave four exams over the course of the 18 week study period with questions from homework assignments 1-5 on the first test, 6-12 on the second, 13-16 on the third, and 17-18 on the last exam. Teacher B designed 5 exams and included TIPS/ATIPS questions from assignments 1-4 on the first exam, 5-7 on the second, 8-11 on the third, 12-13 on the fourth, and 14-18 on the final exam. Teacher C from eighth grade gave 6 exams including the questions over the study period (1-5; 6-9; 10-11; 12-13; 14-15; 16-18), and Teacher D from eighth grade gave 9 exams over the course of the 18-week study period that included TIPS/ATIPS test questions (1; 2-4; 5; 6; 8-9; 10-11; 12-13; 14-17; 18).

Surveys

After students completed all relevant TIPS and ATIPS assignments and related science exams through the first two marking periods, they completed a confidential in-class survey. Children also delivered their parents a survey and informed consent form to complete and return to school.

Measures

This study included a variety of independent and dependent measures. Because participants in this study varied in terms of ability level, prior science achievement, and family background, the following independent measures were collected to control for such differences: prior achievement, mother education level, student ability level, student race, gender, and grade. Condition (TIPS or ATIPS) served as the experimental variable in the study. Homework completion, family involvement, time on homework, science achievement, and science attitudes served as the dependent constructs in the study. See Table 2-2 for a more complete description of the measures used to define the dependent constructs.

Background Measures

Most of the background measures including overall science grade from the year prior, previous standardized reading and math scores, gender, grade, and class ability grouping came from the student record or class roster. Age of student and other measures not used in the analyses came from the student surveys.

Homework Completion Measures

The author recorded homework data each week by student number for various measures of homework completion. Specific homework data collected from both the

TIPS and ATIPS assignments included the following: return of homework assignment (yes or no); lateness of the assignment (turned in late or not turned in late); if late, the number of days late (0 or more days late); completion of the homework assignment (yes-all sections answered, only some sections answered, no sections answered); marking of teacher-assigned homework grade (1-10 points); and total points received for the interactive family sections (0-6 points) on the TIPS assignments or the related questions from the ATIPS assignments.

Additional data from the TIPS assignments only included the name or relationship of the family partner to the student, gender of the family partner (male, female, could not be determined), the presence of a parent signature (yes or no), the answers to the questions in the Home-to-School Communication Section, and any parent or other family member comments made on the assignment itself. Each Home-to-School Communication Section of every TIPS science homework assignment included the following three questions: "My child understood the homework and was able to discuss it; My child and I enjoyed the activity; This assignment helped me know what my child is learning in science." For each of the TIPS assignments, the author recorded a response of "yes," "no," or missing data.

Survey Measures

The purpose of the survey was to gather necessary information about family involvement from both the ATIPS and TIPS groups, additional family background information, time on homework, opinions of the science assignments, and student interest in science. Where possible, questions were written so that the parent and child responses could be compared to investigate how the role of discrepancy and concordance in parent-child responses relates to some of the dependent variables of interest. Surveys used in previous studies of parental involvement in homework were collected to create and design the specific components of the parent and child surveys in the present study (Balli, 1995; Epstein & McPartland, 1978; Epstein, Simon, & Salinas, 1997; Grolnick, Ryan, & Deci, 1991; Levin et al., 1997).

Family involvement

Three questions from the student survey (1a, 1b, 1c) were used to gauge levels of family involvement in the TIPS and ATIPS groups for math homework, language arts homework, and the science homework assignments. The same questions appeared on the parent survey to observe differences in student and parent reports (1a, 1b, 1c). Two additional questions on both the parent and student surveys required the respondent to gauge how often the student worked with a parent on the science green sheets or someone else at home other than a parent (2a, 2b). Finally, all students recorded all the people who worked with them on any of the TIPS/ATIPS homework assignments as well as the person who helped the most (2c, 2d).

Family background

Students answered several survey questions about themselves and their families. Questions included their ages, the number of adults and children living at home, race, their mother's education level, and employment status of their mothers and fathers (12b, c, d, e, f, g, & h).

Time on homework

Students and parents verified how much time is typically spent on various homework tasks. Both groups checked how much time the student spent on homework for all subjects in an average week, for science homework in an average week, and on one typical TIPS/ATIPS science homework assignment. The final question asked how much time a parent or family partner spent with the student on a typical green sheet (student- 3, 4, 5, 6; parent- 4, 5, 6, 7).

Opinions of the TIPS/ATIPS homework assignments

Students and parents answered 11 of the same questions regarding their opinions of the green science homework sheets (student- 7a, b, c, d, e, f, g, i, j, l, & m; parent 3a, b, c, d, e, f, g, h, i, j, & k). Students only answered one additional question about their liking of the green sheets as compared to regular homework (7h). Epstein and colleagues (1997) used similar questions in their investigations of TIPS Language Arts interactive homework in the middle grades.

General interest in science

Three questions from the Commitment to Classwork subscale of the Quality of School Life Scale (Epstein & McPartland, 1978) were included on the student survey (8, 9, 10). The purpose of the Commitment to Classwork subscale is to measure student interest in classwork in general or by subject. For purposes of the present study, commitment to and interest in science classwork was of most interest.

In addition, during the first few weeks of the intervention, all students completed a nine-question survey of their interest in science, math, English, life sciences, physical sciences, and specific areas of science covered by that grade's curriculum. The same nine questions were included on the final survey given after all 18 assignments were completed to analyze change in science interest over the course of the 18 weeks (11).

Table 2-2. Independent and dependent constructs and variables

Construct	Variables
Background variables	Previous science, English, and math achievement Mother education level Employment status of mother and father Age of student Class ability grouping of student Race of student
Independent variables	
Variables of interest	Gender Grade Condition Teacher
Dependent variables	
Homework completion	Percent of TIPS/ATIPS homework assignments returned Percent of assignments completed Percent of assignments returned late Average points earned per assignment Percent of family points earned per assignment
Science achievement	Percent of TIPS/ATIPS test questions correct Average test score of tests including TIPS/ATIPS questions Science report card grades
Science attitudes	Interest in science Interest in science class Opinions of the TIPS/ATIPS homework assignments*
Time on homework	Time on all homework each week* Time on all science homework each week* Time on a typical science TIPS/ATIPS assignment* Family time on a typical TIPS/ATIPS assignment*
Family involvement in homework	Family involvement in science homework* Parent involvement in science homework* Non-Parent family involvement in science homework* Family involvement in language arts homework* Family involvement in math homework*

* Both parent and student reports were collected.

Science Achievement Measures

Three main types of achievement measures were collected: report card grades in science, percent of TIPS/ATIPS assignments answered correctly, and average science test/quiz score for those exams including TIPS/ATIPS science questions. Each teacher assigned different point values to the TIPS/ATIPS test questions; however, each student's score for the percent correct was computed based on the total points earned over the total points possible for each teacher. Average science test/quiz score was adjusted similarly so that average score was based on points assigned to each test rather than the average of the exam score grades which would not fairly account for the individual teacher's grading systems.

Research Questions, Hypotheses, and Analyses

Family Involvement

The first research question concerned the relationship between homework condition (interactive and non-interactive) and reported levels of family involvement with science homework. Because the TIPS assignments were specifically designed to elicit family involvement, it was hypothesized that higher mean levels of family involvement would be associated with this homework condition.

Several questions on the survey asked students and parents to rate family involvement levels in science, English, and math homework. The second family involvement research question asked whether parental involvement levels differed across subjects by science homework condition. Based on results from Balli (1995), it was predicted that parental involvement levels would be higher for the TIPS group in science; however, involvement levels in other subject areas (math and language arts) would not statistically differ by science condition (interactive and non-interactive). If this proved true, we would have additional evidence that the design of TIPS science assignments elicited more involvement than traditional homework assignments in other subject areas. Ordinary least squares regression analyses helped to answer these two family involvement research questions.

Homework Assignments

Students in the study completed 18 assignments over the course of the study period. The next research question addressed how the number of homework assignments turned in as well as the average number of points per assignment relates to homework group and grade of student. The hypothesis predicted that students in the TIPS condition would turn in more assignments and earn more points per assignment than students in the ATIPS condition because they completed the assignments with a family partner. Regression analyses examined the effects of the various background measures and the experimental variable of condition on homework completion measures.

Extending the research question further, did those students who more regularly involved family members (regardless of condition) turn in more accurate assignments than those not involving family members? The hypothesis predicted that TIPS students who involved family members regularly would benefit more academically than ATIPS students because the TIPS condition included instructions for such involvement. Bivariate correlations of family involvement and homework completion measures assessed the relationships for the entire sample of students as well as by condition and by grade.

Science Achievement

Every educator wants to know the effectiveness of a homework intervention on student achievement. Therefore, I investigated two questions related to science achievement. I first examined whether or not there were significant differences in posttest achievement of students by condition and by grade. Again, it was expected that controlling for various background variables including mother education level and previous grade in science, students in the TIPS group would outperform those students in the ATIPS group because of the interactive nature of assignments that is likely to promote student achievement.

Additionally, I predicted that regardless of condition, the more assignments completed would be related to higher science test scores and or grades. Previous research supports the hypothesis in that the amount of homework middle grade students completed positively related to achievement (Cooper et al., 1998). OLS regression analyses again examined these relationships.

Concordance in Parent and Child Surveys

The nature of the survey data permitted exploratory analyses of correspondence and divergence in parental and child reports of family involvement and opinions of the TIPS/ATIPS science homework. Looking at the parent and student surveys, one may note the similarity in wording to allow direct comparisons of parent and student views on the same question.

Researchers are interested in how agreement or discrepancy in parent and child views may relate to various outcomes for students (Goodnow, 1992, 1995). Therefore, correlations determined overall agreement /discrepancy in parent and student reports. It was predicted that those students having student and parent reports that were more positive and similar would earn the highest science grades, turn in more homework assignments, and enjoy science class the most. OLS regression analyses and mean comparisons by group examined the effects of the agreement in reports on selected student achievement measures.

CHAPTER 3
RESULTS

This study examined the effects of interactive (TIPS) and non-interactive (ATIPS) science homework assignments on student science achievement, student and family attitudes about science homework, and family involvement in homework. This chapter includes descriptive and inferential analyses of data to answer the research questions related to family involvement, homework completion, student achievement, and concordance in parent and student reports of family involvement in homework, time on homework, and opinions of science homework.

Descriptive Statistics

Appendix G includes descriptive data for all study variables. Means or frequency and sample size data are provided for specific background, homework completion, science achievement, interest in school, family involvement in homework, time on homework, and opinions of the science homework variables. The sections that follow highlight data from the appendix and selected correlations related to the regression models. This chapter includes many references to "science homework" or "science assignments," and these terms refer only to the TIPS and ATIPS weekly assignments.

Family Involvement Research Questions

The first research question examined the relationship between homework condition (TIPS and ATIPS) and family involvement in science homework at home. Figure 3-1 displays levels of family involvement in science homework by condition.

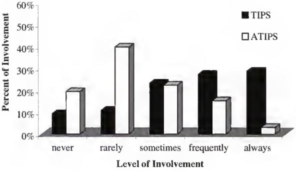


Figure 3-1. Student reported levels of family involvement in science homework by condition (N = 226)

The white bars in Figure 3-1 represent ATIPS student reports (n = 98), while the black bars represent students in the TIPS condition (n = 128). Over 80% of students in the ATIPS condition said their families were never, rarely, or sometimes involved in the science homework assignments over the 18-week study period. In contrast, 80% of TIPS students said their families were sometimes, frequently or always involved in science homework assignments.

Of interest is whom students reported working with on science homework. Seventy-four percent (74%) of students reported working with their mothers on at least one of the science assignments (167/226). Forty-seven percent (47%) of students who completed the survey said their fathers were involved in at least one homework assignment (106/226). Eighteen percent of students reported help from a sister, and sixteen percent reported help from a brother at least once. Twenty-seven percent of students said they received homework help from a relative other than immediate family or a friend at least once. These relatives and friends included cousins, grandparents, neighbors, aunts, uncles, and others. Students also described who helped with science homework most frequently. Fifty-eight percent (58%) of students named mothers helping with homework most often, 17% of students named fathers, 11% named a sister or brother, and 5% named a friend, and the remaining 9% named neighbors, aunts, uncles, grandparents, and others.

Parent reports of involvement followed the same pattern as the student reports with most TIPS parents marking sometimes, frequently, or always involved, while most ATIPS parents marked never, rarely, or sometimes involved in science homework. A positive and significant correlation ($\underline{r} = .669$, $\underline{p} < .001$, $\underline{n} = 177$) exists between parent and student reports of family involvement in science homework. Because the student survey return rate (89%) exceeded the parent return rate (71%) and the patterns of student and parent were similar, student reports of family involvement served as the dependent measure for family involvement in science homework.

Ordinary least squares (OLS) regression analyses calculated the effects of various background measures and homework condition on family involvement in science homework. Table 3-1 displays the results of the regression analysis.

To control for variations in the TIPS and ATIPS groups, previous science achievement, mother education level, class ability grouping of student, race of student, gender, and grade served as the background control variables. The first model includes those variables and accounts for only 6% of the variance in family involvement levels in science homework. Honors students had significantly higher family involvement levels in model 1 than did average students ($\beta = .26$; $p < .01$), and sixth grade students reported significantly higher levels of involvement than did eighth grade students ($\beta = .25$; $p < .01$). Sixth grade students reported a mean level of involvement of 2.37, while eighth grade students reported a mean level of 1.73 on a scale of 0 to 4.

Table 3-1. Predictors of student reported levels of family involvement in science homework (N = 226)

Variable	Model 1		Model 2	
	β	t	β	t
Prior science achievement	.01	0.08	.02	0.29
Mother education level				
(reference- college graduate)				
High school	.09	1.14	.07	0.95
Some college	.03	0.32	-.02	-0.21
Graduate school	.01	0.16	.00	0.03
Class ability grouping				
(reference- Average)				
Low	.09	1.12	-.15	-1.68
Honors	.26	2.90**	.01	0.05
Race				
(reference- White)				
Black	-.00	-0.02	-.03	-0.35
Other	.09	1.10	.05	0.68
Gender				
(Male = 1, Female = 0)	.01	0.08	.03	0.36
Grade				
(Grade 6 = 1, Grade 8 = 0)	.25	2.94**	.21	2.68**
Condition				
(TIPS = 1, ATIPS = 0)			.45	5.40**
R^2/Adjusted R^2	.11/.06		.24/.19	

Note. $\Delta R^2 = .129$ for Model 2 ($p < .01$). *$p < .05$. **$p < .01$.

Model 2 adds the effect of homework condition to the previous model and accounts for 19% of the variance in student reported levels of family involvement in science homework. Condition is the most predictive variable in the model such that TIPS students reported significantly higher levels of family involvement in science homework than did those in ATIPS classes ($\beta = .451$; $\underline{p} < .001$). Again, sixth grade students reported more involvement of families in science homework than eighth grade students, but classroom ability grouping failed to explain a significant portion of the variance when condition was added to the model. Also worthy of mention is the fact that previous science achievement did not predict a significant portion of the variance in family involvement for these TIPS/ATIPS science homework assignments. Therefore, students of all class ability grouping levels and varying previous grades in science did not differ in their reported levels of family involvement, but students in the TIPS condition did report higher levels of involvement than ATIPS students.

Another survey question asked students to report specifically on how often their parents (not just any family member) participated in the science homework. When this variable is used in the previous model as the dependent measure of family involvement in science, the same pattern emerged with condition (TIPS or ATIPS) as the strongest predictor of family involvement in science. Subsequent analyses include the family involvement measure, not the parent involvement measure.

One might wonder whether students in the TIPS condition had families who were already more involved in student homework than the families of ATIPS students, or if involvement in science homework generalized to other subject areas. The second research question examined levels of family involvement of the TIPS/ATIPS science grouping across subjects where TIPS/ATIPS assignments were not used.

Figure 3-2 displays the family involvement means by school subject for the TIPS and ATIPS science homework conditions. According to the graph, the mean for TIPS family involvement levels in science ($\underline{M} = 2.55$) exceeds the ATIPS mean ($\underline{M} = 1.43$). The math and language arts family involvement levels do not dramatically differ by science condition. Importantly, as with science, parent reports of involvement followed the student reports, and parent and student reports are positively correlated for math and language arts ($\underline{r} = .384$, $\underline{p} < .001$, $\underline{N} = 176$; $\underline{r} = .380$, $\underline{p} < .001$, $\underline{N} = 176$).

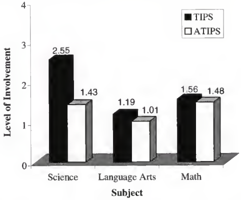


Figure 3-2. Student reported levels of family involvement in science, math, and language arts (N = 226) by science homework condition (TIPS and ATIPS)

Table 3-2 displays results of the regression analysis of variables predicting family involvement in language arts homework. None of the variables in models 1 or 2 predict a significant amount of the variation in student reports of family involvement in language arts homework. Unlike the previous analysis for science homework, TIPS science students did not differ from ATIPS science students in their reports of family involvement for language arts, a subject where interactive homework was not utilized. No additional variance is explained by science condition (TIPS/ATIPS). The patterns for math are similar to language arts in that none of the variables predict a significant portion of the variance in math homework family involvement levels.

Table 3-2. Predictors of student reported levels of family involvement in language arts homework (N=226)

Variable	Model 1		Model 2	
	β	t	β	t
Previous English achievement	- .09	- 0.85	- .11	- 1.01
Mother education level				
(reference- college graduate)				
High school	.12	1.34	.11	1.24
Some college	.02	0.24	.01	0.12
Graduate school	- .09	- 1.01	- .09	- 1.03
Class ability grouping				
(reference- Average)				
Low	.15	1.50	.09	0.76
Honors	- .11	- 1.18	- .16	- 1.47
Race				
(reference- White)				
Black	- .02	- 0.21	- .03	- 0.33
Other	.05	0.59	.04	0.47
Gender				
(Male = 1, Female = 0)	.08	0.97	.08	0.99
Grade				
(Grade 6 = 1, Grade 8 = 0)	.15	1.77	.15	1.73
Condition				
(TIPS = 1, ATIPS = 0)			.09	0.95
R^2/Adjusted R^2	.18/.13		.19/.13	

Note. $\Delta R^2 = .005$ for Model 2 ($p = .901$, NS). $*p < .05$. $**p < .01$

In summary, results of the family involvement analyses indicate that TIPS students reported higher levels of family involvement in science homework than did ATIPS students. Because these students and families received explicit information for family involvement on science homework through a letter and instructions on each TIPS assignment, it is not surprising that the results differ by condition. Math and language arts family involvement levels did not differ by science condition. Therefore, one can conclude that the TIPS condition and instructions for family involvement in science elicited more family involvement in science homework, but not math or language arts homework. This alerts researchers and educators to the importance of subject-specific instructions for family involvement. The next analyses examined the effects of family involvement in science homework on homework completion and accuracy.

Homework Completion and Accuracy

The second main research question investigated differences in the return rates and accuracy of students' science homework by condition, teacher, grade, and gender. Table 3-3 presents the means and standard deviations of percent of assignments returned and the average points earned, by homework condition (TIPS or ATIPS), gender, grade (6 or 8), and teacher (Teacher A, B, C, or D).

It was hypothesized that students in the TIPS condition would complete more and turn in more accurate assignments than students in the ATIPS condition because of the involvement of their families. In contrast to the hypothesis, the means by condition do not reveal an advantage for the TIPS students in terms of turning in more complete and accurate homework assignments. Table 3-3 shows that students in the ATIPS condition

(75.9%) turned in slightly more of the weekly assignments than did TIPS students (71.8%) (with about the same average points earned per activity).

Developmental differences emerged with eighth grade students turning in slightly more assignments than students in sixth grade. Results also differed by gender with female students turning in more and earning more points for their homework assignments than male students.

There were strong differences by teacher, with students taught by Teachers A and D turning in more assignments than Teachers B and C. Teachers A and D made a point to remind students more than once during the week of the importance of completing the science homework. As a result of this instruction, more students in those classes consistently returned and earned more points on their science homework assignments.

Additional investigation of the effects of the various background variables on homework completion and average points per assignment required the use of OLS regression analyses. Because the homework groups differed in terms of classroom ability grouping and previous science achievement, it was necessary to control for these differences to assess the true effects of the TIPS intervention on homework completion and accuracy.

Table 3-4 displays four regression models. Model 1 includes background variables and teacher effects and accounts for 32% of the variation in homework returned. Teacher effects and previous science achievement accounted for a significant portion of the variation in the percent of homework returned. Higher previous science achievement as measured by the previous year's report card grades related to more assignments returned.

In addition, Teacher A's students returned significantly more assignments than any other teacher's students. In fact, when the teacher dummy variables are entered separately, they add significant predictive power to the model.

Table 3-3. Means, standard deviations, and number of students for homework completion and accuracy by condition, grade, gender, and teacher over 18 assignments

Subsample		Percent of assignment returned		Average homework points	
	n	M	SD	M	SD
TIPS	132	71.8	26.3	6.2	2.6
ATIPS	101	75.9	23.4	6.3	2.2
Grade 6	128	72.6	27.1	6.1	2.6
Grade 8	105	74.8	22.6	6.4	2.2
Male	123	70.7	26.1	5.9	2.5
Female	110	76.9	23.6	6.6	2.4
Teacher A (6)	61	87.9	19.7	7.1	2.4
Teacher B (6)	67	58.7	25.3	5.2	2.5
Teacher C (8)	50	69.1	23.1	5.8	2.1
Teacher D (8)	55	80.0	20.9	6.9	2.2
Total	233	73.6	25.1	6.2	2.5

Note: Maximum number of homework points was 10.

Model 2 adds the effects of condition to the background variables and teacher effects. Contrary to the hypothesis, TIPS and ATIPS students did not differ significantly in the percent of homework assignments they returned, and condition failed to predict a significant amount of variation in the model. Model 3 adds the student reports of family involvement in science homework, which does account for a significant portion of the variation. Students who more frequently involved family members in homework returned more science assignments.

The most complete model, Model 4, includes all previous variables and adds the effect of the student opinion of science homework. This measure is the average of a scale of nine items on the student survey relating to student reports of how much they and their parents liked the assignments, whether the assignments should be used next year, and whether or not the student liked sharing science work with family partners at home ($\alpha = .75$). The more positive a student's opinion of the science homework, the more assignments the student returned ($\beta = .20$, $p < .01$). Worthy of note is the fact that when the student opinion rating is added to the equation, the predictive power of family involvement is reduced ($\beta = .139$, $p = .053$).

Another homework variable of interest relates to average points earned per assignment over the 18-week study period. Table 3-5 below includes the same predictors used in Table 3-4.

Similar to homework assignments returned, condition failed to predict a significant portion of the variation in average homework points earned per assignment. Unlike the homework return model, working with a family partner on science homework ($\beta = .156$, $p < .03$) remained significant in the model including student opinion of the science homework ($\beta = .212$, $p < .003$). Worthy of note is the fact that teacher effects predicted more variance in the previous two models than did students' grade in school. Students in the low ability classes earned fewer points per assignment than did average classes of students. Classroom ability level and previous grade in science were significantly correlated ($r = .365$, $p < .001$, $N = 239$). However, being in an honors class is even more strongly correlated with previous grade in science ($r = .405$, $p < .001$, $N = 239$) than being in a low class ($r = -.162$, $p < .05$, $N = 239$). This strong relationship between the honors class grouping and previous grade in science may explain the lack of significance for the honors grouping (Honors) alone, as much of the variance in this variable is explained by previous science grade.

The model also indicates that black students in the sample earned fewer points than did white students. This was unexpected as previous science grade and class ability grouping are controlled in the analysis. Therefore, one might expect there to be no difference in accuracy of homework by race of student.

Tables 3-4 and 3-5 indicate a significant and positive relationship between family involvement in science homework and homework completion and accuracy. Table 3-6 addresses the second homework completion research question about the relationship between family involvement and homework completion by condition.

Looking at the correlations separately by condition, TIPS students who more often involved family members turned in significantly more assignments ($r = .29$) and earned more average points per assignment ($r = .32$) than did students not involving family members as often.

Table 3-4. Predictors of Number of Homework Assignments Returned (N = 233)

Variable	Model 1		Model 2		Model 3		Model 4	
	β	t	β	t	β	t	β	t
Prior science achievement	.29	3.64**	.29	3.61**	.29	3.68**	.29	3.13**
Mother education level (reference- College graduate)								
High school	-.13	-1.80	-.13	–1.79	-.14	–2.03*	-.11	–1.63
Some college	-.07	-1.02	-.08	-1.01	-.08	–1.01	-.07	–1.01
Graduate school	-.00	-0.03	-.00	-0.03	-.00	-0.03	.01	0.18
Class ability grouping (reference- Average)								
Low	-.14	-1.94	-.14	-1.66	-.11	-1.37	-.10	-1.20
Honors	-.13	-1.62	-.13	-1.37	-.13	–1.46	-.13	-1.47
Race (reference- White)								
Black	-.11	-1.46	-.11	-1.45	-.10	–1.41	-.09	-1.31
Other	-.07	-1.00	-.07	-0.99	-.08	–1.18	-.09	-1.32
Gender (Male = 1, Female = 0)	-.08	-1.24	-.08	-1.24	-.08	–1.33	-.09	-1.47
Teacher (reference- Teacher A)								
Teacher B (6)	-.54	–6.97**	-.54	-6.94**	-.54	–7.01**	-.49	–6.41**
Teacher D (8)	-.17	-2.21*	-.17	-2.20*	-.15	–1.88	-.06	-0.73
Teacher C (8)	-.24	-2.78**	-.24	-2.73**	-.19	–2.18**	-.16	-0.18
Condition (TIPS = 1, ATIPS = 0)			-.01	.99	-.08	-.98	-.05	-0.63
Student report of family involvement					.19	2.68**	.14	1.95
Student opinion of science homework							.20	3.01**
R^2/Adjusted R^2	.37/.32		.37/.32		.39/.34		.43/.37	

Note: ΔR^2 = .000 for Model 2 (p = .991); ΔR2 = .027 for Model 3 (p = .008); ΔR2 = .032 for Model 4 (p = .003); *p < .05. **p < .01

Table 3-5. Predictors of accuracy of science homework assignments returned (N = 233)

Variable	Model 1		Model 2		Model 3		Model 4	
	β	t	β	t	β	t	β	t
Prior science achievement	.32	4.03**	.33	4.14**	.33	4.24**	.33	4.34**
Mother education level								
(reference- College graduate)								
High school	-.13	–1.79	-.13	–1.84	-.15	–2.12*	-.12	–1.70
Some college	-.10	-1.36	-.11	-1.45	-.11	–1.47	-.11	–1.49
Graduate school	.01	0.14	.01	0.12	-.01	0.12	.02	0.34
Class ability grouping								
(reference- Average)								
Low	-.16	-2.27*	-.20	-2.36*	-.17	–2.05*	-.15	-1.89
Honors	-.03	-0.43	-.07	-0.79	-.08	– 0.88	-.08	-0.88
Race								
(reference- White)								
Black	-.18	-2.54*	-.19	-2.59*	-.19	–2.57*	-.18	–2.50*
Other	-.08	-1.15	-.08	-1.24	-.10	–1.46	-.10	-1.62
Gender								
(Male = 1, Female = 0)	-.09	-1.36	-.08	-1.31	-.09	–1.42	-.10	-1.57
Teacher								
(reference- Teacher A)								
Teacher B (6)	-.37	–4.74**	-.37	-4.76**	-.36	–4.80**	-.31	-4.17**
Teacher C (8)	-.15	-1.74	-.14	-1.57	-.08	–0.97	-.05	-0.59
Teacher D (8)	-.09	-1.10	-.09	-1.13	-.06	–0.76	.03	0.41
Condition								
(TIPS = 1, ATIPS = 0)			.06	.81	-.03	-0.31	.01	0.07
Student report of family involvement					.21	3.00**	.16	2.24*
Student opinion of science homework							.21	3.19**
R^2/Adjusted R^2	.38/.33		.38/.33		.41/.36		.45/.39	

Note. $\Delta R^2 = .003$ for Model 2 ($p = .652$, NS); ΔR2 = .033 for Model 3 ($p = .003$); $\Delta R^2 = .035$ for Model 4 ($p = .002$); *$p < .05$. **$p < .01$.

In the ATIPS group, no significant correlations exist between student reports of involvement in science homework and homework completion or average points per homework assignment. For both the ATIPS and TIPS conditions, higher opinions of the science homework correlated significantly and positively with return of assignments and average points per assignment. In the TIPS condition only, more positive homework opinions correlated with higher levels of family involvement in science homework.

Table 3-6. Intercorrelations for homework completion, homework accuracy, family involvement, and homework opinions by homework condition

Variable	1	2	3	4
		TIPS (n = 132)		
1. Homework completion	--	.95**	.29**	.25**
2. Average homework points	.95**	--	.32**	.24**
3. Family involvement	.29**	.32**	--	.34**
4. Student homework opinions	.25**	.24**	.34**	--
		ATIPS (n = 101)		
1. Homework completion	--	.93**	.01	35**
2. Average homework points	.93**	--	.00	34**
3. Family involvement	.01	.00	--	.11
4. Student homework opinions	.35**	.34**	.11	--

Note. *p < .05. **p < .01

Contrary to the hypothesis, TIPS students did not differ significantly from ATIPS students in terms of the number of science homework assignments returned and the average number of homework points earned. However, regression analyses indicated a positive relationship between family involvement and student opinions of the assignments on homework accuracy and completion. In fact, correlations of the TIPS and ATIPS groups separately revealed an important distinction in the effects of these two variables. TIPS students turned in more assignments when family involvement levels were higher and their opinions of the science activities were more positive. Though ATIPS students turned in more assignments when they rated them more positively, family involvement showed no relation to homework completion or accuracy in this condition.

This is interesting because both groups of students received the same science questions on the assignments. ATIPS students who involved families without instruction to do so did not receive the same benefit as TIPS students who involved families in science homework in planned and productive interactions. This suggests the importance of the letter to parents, instructions on the TIPS assignments for family involvement, and the comments from teachers to students to involve family members in their homework assignments.

Science Achievement

The next research question addressed the impact of the TIPS intervention on student science achievement. Three measures of student achievement were analyzed in the study: 1) average science report card grades for two marking periods; 2) average percent of homework test questions answered correctly; and 3) average test scores from tests including the TIPS/ATIPS questions. Table 3-7 presents the means and standard deviations of these three measures of science achievement by condition (TIPS or ATIPS).

For all three science achievement measures, TIPS students outperformed ATIPS students. Further investigation of the relationship between family involvement and science achievement remains vital, as these means do not take into account background differences among students in the sample. Table 3-8 shows the regression analysis for student science report card grades.

Table 3-7. Means and standard deviations for science achievement measures over 18 weeks by condition

Variable	TIPS n = 135 M	 SD	ATIPS n = 105 M	 SD
1. Science report card grade	2.79	1.03	2.52	1.10
2. Homework test questions	78.07	14.68	72.50	14.82
3. Average science test score	78.65	13.00	75.78	11.19

Model 1 in Table 3-8 accounts for 50% of the variation in report card grades. Higher previous science achievement related to higher report card grades in science. Students with mothers having high school or some college education had lower report card grades than students with mothers having a college degree. Race of student predicted a significant portion of the variance with black students earning lower report card grades than white students in the study. As with the homework completion models, this finding is puzzling as previous science grade and class ability grouping are controlled. Male students earned significantly higher report card grades than females.

Student reported levels of family involvement in science failed to predict a significant portion of the variation in report card grades for the entire sample. When the student report of family involvement is replaced with the student reported levels of parent involvement, parent involvement does predict a significant portion of the variation in Model 1 only ($\beta = .132$, $p = .021$). When percent of homework completed and condition are added to the model, parent involvement fails to predict significant variation just as family involvement does. Therefore, other variables in this model carry more of the variance in predicting report card grades than either of the family involvement measures.

Another important science achievement research question asked how the percent of assignments returned relates to science achievement. Model 2 demonstrates that students who completed more of the science homework assignments earned higher report card grades. This finding supports the fact that both the ATIPS and TIPS assignments had clear purposes and objectives and both represented high quality homework assignments that, when completed, should relate to higher report card grades. Studies of middle school homework completion and achievement confirm this result and demonstrate the positive relation between the two (Cooper, 1998; Keith et al., 1993).

Percent of homework assignments returned strongly related to report card grades ($\beta = .461$, $p < .001$). After controlling for the background variables and percent of homework assignment returned, students in TIPS still earned higher report card grades than students in ATIPS. This finding is exciting because it suggests the importance of not only completing homework, but also completing specifically the TIPS interactive homework.

Table 3-8. Predictors of science report card grades (N = 240)

Variable	Model 1		Model 2		Model 3	
	β	t	β	t	β	t
Prior science achievement	.39	5.72**	.25	4.19**	.26	4.39**
Mother education level						
(reference- College graduate)						
High school	-.13	-2.18*	-.07	-1.27	-.07	-1.33
Some college	-.17	-2.62**	-.13	-2.36*	-.15	-2.65**
Graduate school	-.03	- 0.45	-.03	-0.50	-.03	-0.57
Class ability grouping						
(reference- Average)						
Low	-.05	- 0.73	.03	0.47	-.05	-0.80
Honors	-.00	-0.01	.08	1.31	.00	0.06
Race						
(reference- white)						
Black	-.22	-3.54**	-.18	-3.22**	-.18	-3.40**
Other	-.11	-1.90	-.07	-1.43	-.08	-1.64
Gender						
(male=1)	-.09	1.65	.13	2.69**	.14	2.89**
Teacher						
(reference- Teacher A)						
Teacher B (6)	.12	1.85	.37	5.65**	.37	5.75**
Teacher D (8)	-.36	-5.31**	-.29	-4.95**	-.30	-5.18**
Teacher C (8)	-.12	-1.58	-.04	-0.56	-.02	-0.34
Student report of family involvement	.07	1.15	-.01	-0.17	-.06	-1.04
Percent of homework returned			.45	7.75**	.46	8.02**
Condition (TIPS=1)					.15	2.41*
R^2/Adjusted R^2	.54/.51		.67/.64		.68/.65	

Note. $\Delta R^2 = .12$ Model 2 ($p = .00$); $\Delta R^2 = .01$ Model 3 ($p = .02$); $*p < .05$. $**p < .01$.

Examination of the means by condition revealed the fact that TIPS students earned higher report card grades, answered more TIPS/ATIPS test questions correctly, and earned higher science test scores than ATIPS students. Even after controlling for background measures, teacher effects, and percent of homework completed, TIPS students still earned significantly higher report card grades than ATIPS students in regression analyses. This model accounted for 65% of the variance in report card grades. When these same variables were controlled for average test score in science, condition failed to predict a significant portion of the variance above and beyond percent of homework returned. Condition predicted a significant portion of the variance in percent of TIPS/ATIPS test questions answered correctly, but the model only explained 7% of the variance in the test questions.

Results from the first research question revealed the fact that TIPS students more often involved family members in homework assignments than did ATIPS students ($r = .427$, $p < .001$, $N = 226$). However, the regression analyses failed to demonstrate family involvement as a significant predictor in this analysis. Therefore, it is unclear from this study what it is about the TIPS condition that related to higher report card grades for students. The analyses below explore the nature of the involvement relationship for students and parents in both homework conditions to search for clues in the science achievement patterns.

Concordance and Discrepancy in Parent and Student Reports

Family and student survey questions were worded similarly to allow comparison of student and family partner answers to the same question. In most cases, the parent was the one to complete the family survey (95%); therefore, the respondents to this survey will be referred to as parents from this point on. The similarly worded survey questions permitted exploration of how the degree of agreement and positive reports from parents and students related to some of the dependent measures of interest, including measures of homework completion.

Table 3-9 displays the means and standard deviations for the matched sample of students and parents who responded to the survey questions. These variables included questions about time spent on homework, family involvement in homework, and opinions of the science homework.

Family involvement questions were coded on a scale of 0-4 with 0 indicating "never" involved, 1 indicating "rarely" involved, 2 meaning "sometimes" involved, 3 meaning "frequently" involved, and 4 indicating "always" involved in homework. The science homework opinion questions were coded on a scale of 1-4 with 4 indicating strong agreement, 3 indicating agreement, 2 indicating disagreement, and 1 indicating strong disagreement. Time questions were coded on different scales ranging from 0-5, but higher numbers always indicate more time spent on homework. For example, time spent on homework for all subjects was coded as 0 for 0 minutes, 1 for less than 30 minutes, 2 for 30 minutes to 1 hour, 3 for 1-2 hours, 4 for 2-3 hours, 5 for 3-4 hours, and 6 for more than 4 hours.

In 14 of the 19 cases, parents had more positive reports, on average, than did students. Family members completing the surveys (74% mothers, 21% fathers, 5% grandparents, neighbors, or other) tended to be more positive about science homework, tended to estimate that students spent more time on homework, and rated their involvement in homework for English, science, and math higher than students did. For two of the 18 cases, the student and parent means did not differ. Their mean responses for students liking to share their work with someone else at home other than a parent were the same. Similarly, parents and students did not differ in their ratings of how often parents took part in science homework. In three cases, parents' reports were lower than students' reports. Parents reported spending slightly less time on science homework than students reported that they did. A larger mean difference in parent and student reports occurred when parents were asked if they needed more information from the school about the green science homework sheets. Parents said they needed more information than students reported that their parents needed. Finally, parents did not report as high as students that students work as hard as they can in science.

A scale composed of nine of the survey items was constructed to examine the relationships between student ($\alpha = .76$) and parent ($\alpha = .79$) opinions concerning the science homework assignments. These questions asked students and parents to rate their liking of the TIPS/ATIPS science assignments, to record whether or not the homework took too much student or family time, whether or not these should be used next year, and several other questions.

The scale included the variables with a star (*) in the table above. A score of 1 indicated strong disagreement, 2 indicated disagreement, 3 indicated agreement, and 4 indicated strong agreement. Students reported a mean of 3.11 ($\underline{SD} = .54$) for these 9 items, while parents reported a mean of 3.36 ($\underline{SD} = .59$). A significant and positive correlation ($\underline{r} = .437$, $n = 164$, $p < .001$) exists between the student and parent reports.

Table 3-9. Matched sample of student and parent means for survey questions

Construct/ Variable Description	Student N = 175 M	 SD	Parent N = 175 M	 SD
TIME ON HOMEWORK				
Time on homework for all subjects	3.30	1.54	4.39	1.61
Time on science homework only	1.68	0.76	2.09	0.92
Time on one science homework assignment	1.92	0.82	2.29	0.91
Family partner time on one science assignment	1.87	0.96	1.83	1.01
FAMILY INVOLVEMENT IN HOMEWORK				
Family involvement in science homework	2.15	1.30	2.36	1.23
Parent involvement in science homework	2.28	1.63	2.27	1.61
Family involvement in English homework	1.14	1.14	1.49	1.16
Family involvement in math homework	1.55	1.25	1.64	1.14
OPINIONS OF SCIENCE HOMEWORK				
These science assignments are a good idea.*	3.23	0.85	3.41	1.05
My family partner liked the science homework.*	2.85	0.94	3.16	1.01
Students should use these next year.*	3.20	0.98	3.28	1.18
The science homework did not take too much student time.*	2.90	0.98	3.18	1.15
The science homework did not take too much of family partner's time.*	3.01	0.97	3.29	1.05
These assignments help parent see what student is learning in science class.*	3.46	0.83	3.54	0.90
Parent does not need more information about the science homework.*	3.11	1.00	2.85	1.23
Parent likes to hear what student is learning in science class.*	3.44	0.74	3.89	0.42
Student works as hard as s/he can in science class.	3.46	0.71	3.19	1.12
Student likes to talk about science with family.*	3.28	0.88	3.56	0.77
Student likes to share science work with someone at home.	2.98	1.06	2.98	1.25

*Questions that comprised the scale of opinions of the science homework.

The student and parent scale means were used to construct categories for student and parent reports of the science assignments. When the student rated homework on the low end of the scale (below the mean for students) and his/her parent rated the homework on the low end of the scale (below the mean for parents), a 0 was assigned to that student. When a student rated the homework low and his/her parent rated it high, a 1 was assigned. In the cases where student rated high and the parent rated low, a 2 was recorded, and when both student and parent rated homework more positively, a 3 was assigned.

Table 3-10 displays the means for three science achievement variables including report card grades, TIPS/ATIPS test questions, and average test score and for two homework completion variables including percent of homework returned and average points earned per assignment. The highest percentage of students (44%) are included in the student high/parent high category, and the remaining three categories include between 15 and 20% of the students in this reduced sample.

The means for high student and parent opinions of the science assignments are higher in all cases than the low student and low parent reports. In addition, the means for student high and parent low are consistently higher than the student low and parent low reports. Inconsistent relationships between the discrepancy patterns emerged with two cases of the student high/parent low mean being slightly smaller than the student low/ parent high mean (report card grades and TIPS/ATIPS test questions). For both homework completion variables, the student low/ parent high report (71.20, 5.99) fell below the low student and low parent reports (79.03, 6.74).

Table 3-10. Means and standard deviations for student science achievement by parent and student science homework categories

Variable	Homework Opinion Similarity Index Category Student Low Parent Low n = 32	Student Low Parent High n = 25	Student High Parent Low n = 32	Student High Parent High n = 69	Total N = 158
Science report card grade	2.62 (0.95)	2.78 (1.14)	2.75 (0.94)	3.12 (0.94)	2.87 (0.99)
Average science test score	77.78 (12.51)	77.97 (11.85)	78.07 (10.45)	80.68 (11.85)	79.13 (11.67)
Percent of TIPS/ ATIPS test questions correct	70.05 (13.16)	78.74 (14.23)	78.59 (12.47)	76.43 (14.74)	75.93 (14.11)
Percent of homework returned	79.03 (22.71)	71.20 (22.31)	82.25 (17.70)	88.03 (17.78)	82.47 (20.25)
Average points earned per homework	6.74 (2.35)	5.99 (2.19)	6.77 (1.88)	7.71 (1.82)	7.06 (2.08)

Note: Maximum science report card grade = 4; Maximum average number of points earned = 10.

The final research question examined the relationship between these student and parent categories of enthusiasm for science homework and specific dependent variables of interest. The following tables (Tables 3-11 and 3-12) include preliminary evidence suggesting that these categories including both student and parent data explain more variance in average points earned per assignment and percent of homework returned than student reports alone. These tables are different from the previous table on homework accuracy (Table 3-5) in that they include fewer background variables (due to the reduced sample). Table 3-5 also did not include any parent reports as the following tables do.

Model 1 of Table 3-11 includes various background measures affecting the average number of homework points students earned. As in many of the regression analyses, the higher the student's previous science grade, the more science homework points he or she earned. Students in the low classroom ability grouping did not earn fewer homework points than did average students, but black students earned significantly fewer points than white students. Male students earned fewer points than females. Model 2 adds the effect of the student rating of science homework finding that students who rated the homework more positively tended to earn more points on science homework.

Contrast Table 3-11 with Table 3-12. Model 1 of Table 3-12 includes the same background variables used in Table 3-11. Model 2 of Table 3-12 includes the parent and student categories of ratings of the homework instead of the student information alone. The addition of the parent information predicts slightly more variance in average points earned. The adjusted R^2 for the model with the student opinion only accounts for 34% of the variance in homework points while the model including the student parent categories accounts for 36% of the variance.

Similar results emerged for the percent of homework returned. Student opinion only accounted for 20% of the variance in percent of homework returned while the student and parent categories accounted for 22% of the variance.

One may wonder what results emerge when the student opinion of the homework is included in a model along with the parent opinion of the homework. This differs from the previous model in that this does not take into account the "fit" between the parent and student opinions for each subject. The variance explained with these two variables is very close to the values computed for the parent and student categories (37% for average points and 21% for percent of homework returned). Therefore, these analyses underscore the importance of including both the family and student opinion in the models.

The unstandardized beta coefficients (B) provided the values to compute the predicted average points earned by the same hypothetical student. For example, imagine that we wanted to know the effect of changing the student or the student/parent category for opinions of science homework on a hypothetical student. Imagine a sixth grade white female student named Isabel in the average class ability group with a 3.0 grade point average in science last year.

$$\begin{aligned}\hat{Y} &= 3.061 + .764\,(3) - .671\,(0) - (.00)\,(0) - (1.14)\,(0) - (.338)\,(0) - 1.00\,(0) \\ &\quad - .451(1) + .954\,(3.5) = 8.241\end{aligned}$$

According to Table 3-11, if Isabel reported high enthusiasm for the science homework, she would earn 8.24/10 average points on homework assignments. Using the unstandardized beta coefficients from Table 3-12, one computes 8.67 average points earned when Isabel and her parent report high enthusiasm for science homework. In contrast, when Isabel's report is high and her parent reports low enthusiasm for the science homework, Isabel earns 7.65 average points on homework.

Figure 3-3 displays the predicted average points earned for Isabel when her enthusiasm for science is high. There is a notable advantage to Isabel when her parent also reports enthusiasm for the science homework. When her parent reports a more negative view of the science homework, Isabel earns fewer points than if just her report of the homework is included.

Table 3-11. Predictors of average points earned per assignment including only the student rating of science homework (N = 153)

Variable	Model 1			Model 2		
	B	β	t	B	β	t
(Constant)	5.92			3.06		
Prior grade in science	0.75	.31	3.74**	0.76	.32	3.96**
Class ability grouping (reference- Average)						
Low	-0.93	- .14	-1.85	-0.67	-.10	-1.36
Honors	-0.00	-.01	-0.09	-0.00	-.01	-0.14
Race (reference- White)						
Black	-1.10	-.25	-3.34**	-1.14	-.26	-3.61**
Other	-0.23	-.03	-0.45	-0.34	-.05	-0.68
Gender (Male = 1, Female = 0)	-0.99	-.24	-3.42**	-1.00	-.24	-3.57**
Grade (Grade 6 = 1, Grade 8 = 0)	-0.13	-.03	-0.39	-0.45	-.11	-1.37
Student opinion of science homework				0.95	.25	3.56**
R^2/Adjusted R^2		.32/.29			.37/.34	

Note. ΔR^2 = .055 for Model 2 ($p < .001$). *$p < .05$. **$p < .01$.

Table 3-12. Predictors of average points earned per assignment including the student/parent category ratings for science homework (N = 153)

Variable	Model 1			Model 2		
	B	β	t	B	β	t
(Constant)	5.92			6.95		
Prior grade in science	0.75	.31	3.74**	0.78	.32	4.09**
Class ability grouping (reference- Average)						
Low	-0.93	-.14	-1.85	-0.75	-.11	-1.54
Honors	-0.00	-.01	-0.09	-0.21	-.05	-0.63
Race (reference- White)						
Black	-1.10	-.25	-3.34**	-1.19	-.27	-3.69**
Other	-0.23	-.03	-0.45	-0.46	-.06	-0.92
Gender (Male = 1, Female = 0)	-0.99	-.24	-3.42**	-0.99	-.24	-3.55**
Grade (Grade 6 = 1, Grade 8 = 0)	-0.13	-.03	-0.39	-0.61	-.15	-1.83
Parent/student category (reference- Student High/ Parent High)						
Student High/Parent Low				-1.03	-.20	-2.78**
Student Low/ Parent High				-1.36	-.24	-3.34**
Student Low/ Parent Low				-1.45	-.28	-3.62**
R^2/Adjusted R^2	.32/.29			.40/.36		

Note. $\Delta R^2 = .084$ for Model 2 ($p < .001$). *$p < .05$. **$p < .01$.

The pattern when Isabel reports a low rating of science homework also deserves attention. Figure 3-4 includes the predicted average points earned when she reports low enthusiasm for science homework assignments. Also included in the graph are the points earned for the two possible student/parent categories. The predicted points when Isabel reports low and her parent reports high are slightly higher than when only Isabel's low report is included in the model. As with high student reports, low reports by the parent results in fewer predicted points than when just the student report is included.

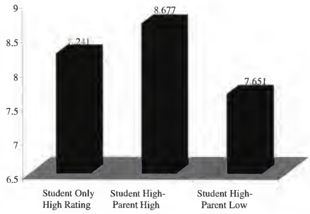


Figure 3-3. Predicted average homework points earned for high student ratings of science homework by the same hypothetical student

These regression analyses and graphs alert researchers to the importance of exploring both parent and student responses when the two parties interact. Knowing the student opinion is certainly most important, as homework is a student's responsibility to complete. However, the nature of interactive homework requires parent or family involvement and these opinions add variance to the regression model that may positively or negatively influence student outcomes such as homework completion and accuracy.

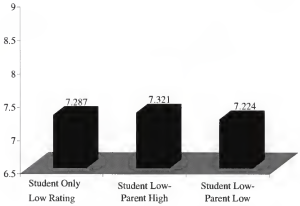


Figure 3-4. Predicted average homework points earned for low student ratings of science homework by the same hypothetical student

Exploratory analyses of the reports of students and parents to various survey questions revealed the tendency for parents to report higher or more positively than students. Parent and student matched reports were significantly and positively correlated.

To summarize the results of the concordance results, regression analyses calculated the additional variance parent and student categories explained beyond student opinions of homework. Graphs of predicted homework points revealed an important pattern for the same hypothetical student. Students may earn more points on homework if they rate homework enthusiastically. A positive parent report in conjunction with a positive student report relates to higher points earned than when just the student report is measured. A negative parent report paired with a positive student report indicates a decrease of average points earned.

When the student report of homework is low, the parent report of the homework may relate to slightly higher points earned than when just the student report is included. These findings are to be taken with caution as 1) they do not imply causation; 2) they do not represent the entire sample of students in the study; 3) the model accounts for 36% of the variance so much of the variance is still not explained by these models. Given these limitations, future research should investigate these student and parent patterns to explore the relationships between positive homework opinions from both the student and family and student outcomes. Teachers, students, parents, and researchers would benefit from deeper knowledge of how these opinions from both student and parent might predict or "boost" completion or accuracy of homework.

CHAPTER 4
DISCUSSION

Previous research on homework paid insufficient attention to the roles of homework design and family interaction in homework. This study explored the effects of interactive and non-interactive well-designed science homework assignments on family involvement, student science achievement, and student science attitudes. The combination of a longitudinal and developmental design involving multiple teachers and varying ability levels of students speaks to real-life variations in middle schools nationwide. This discussion highlights the major findings and limitations of this study, describes "tips" for future research that would help to support and clarify the current findings, and summarizes strategies for brightening the future of homework.

Major Findings

TIPS Increased Family Involvement in Science Homework

The TIPS intervention was successful in promoting higher levels of family involvement in science homework than the ATIPS condition. One TIPS student wrote the following comment on the survey: "I think these sheets (TIPS assignments) were a very good idea because they help my family partner know what I'm doing. I think it is a good practice for tests."

This result supports findings from Balli's (1995) experimental study of middle grade students using TIPS math. The higher level of family involvement in science, however, did not carry over to other subject areas such as language arts and math (subjects not utilizing TIPS homework assignments). The teachers of these subjects did not use TIPS homework assignments. Thus, this alerts researchers and educators to the importance of implementing subject-specific involvement strategies to increase subject-specific results (Epstein, 1991; Epstein, in press; Epstein & Van Voorhis, in press).

Most parents recognize the importance of reading to children at home as an appropriate form of involvement to promote reading achievement, not math achievement. Parents do not often know how to support their children in subjects other than reading without explicit information on what to do. The TIPS design provides the student with activities to involve family partners and instructions for guiding interactions so that parents do not need to figure how they may be involved in their children's homework in appropriate ways. Several parents commented on the survey about their appreciation of the TIPS homework assignments as a means of working together: "They (the TIPS assignments) are a great way for us to work together and keep informed of what is going on at school." Another parent remarked: "I think it is a good idea for the kids to be able to share and to demonstrate for their parents what they are learning in school."

Another important aspect of this finding is the fact that parental education as measured by mother's education did not predict a significant amount of the variation in involvement levels. This TIPS science homework design, therefore, provided *all* families in the study, not just those in the middle or upper classes, with an opportunity to be involved in their children's education. Similar findings emerged in a study of TIPS writing in the middle grades (Epstein et al., 1997).

Family Involvement Relates to Homework Completion

Though it was hypothesized that TIPS students would turn in more assignments and more accurate work than ATIPS students because of the family interaction, the results failed to demonstrate significant differences by condition in homework completion or accuracy. This may be because both the ATIPS and TIPS assignments contained identical content and questions, except for guided family involvement. Teachers focused their energies on developing high quality, purposeful homework assignments linked to their science curriculum indicators. The difference between the two conditions related to the instructions and prompts for family involvement in the TIPS condition only. All students received a maximum of 10 points per assignment, and teachers tested the information from homework on science exams. Therefore, all students had incentives for completing the assignments, and condition (TIPS vs. ATIPS) did not explain whether students did their homework.

Although there were no differences in return rates of TIPS and ATIPS students, higher levels of family involvement and more positive student opinions of science homework did relate to more average points earned per homework assignment. These findings point to important interrelations among student science attitudes, homework completion, and family involvement behaviors. Designing assignments that promote more positive attitudes about science and that thoughtfully involve family partners is an important goal of interactive homework assignments (or any type of homework) that may relate to positive student achievement outcomes. Twenty-three of the 98 students who commented about the science assignments on the survey in both the ATIPS and TIPS groups remarked about their enjoyment of the assignments with experiments. One student commented "I think the green sheets are fun if there is an experiment. The experiment makes learning fun!" Paying attention to these student comments and providing more hands-on learning for students is important in the design of future homework assignments for students at this age (Paris, Yambor, & Packard, 1998).

TIPS Students Earned Higher Report Card Grades than ATIPS Students

After controlling for student background characteristics including prior report card grade in science, teacher effects, and percent of homework completed, TIPS students earned higher science report card grades than ATIPS students. This finding suggests an important link of the TIPS interactive homework with student success in school. This regression analysis represents the strongest model of the study, accounting for 65% of the variance in science report card grades.

Less clear are the specific aspects of TIPS that relate to higher achievement. Because there were no significant differences in homework return rates or homework accuracy of TIPS and ATIPS students, it is not possible to conclude that the science achievement difference by condition is due to TIPS students completing more or more accurate homework assignments. Also, the regression analyses do not suggest that the TIPS advantage is due to the higher levels of involvement of the TIPS students. Deeper investigations of the TIPS process at home and its effects on other variables like school attendance, student perceptions of their teachers and science in general, and ratings of the home interactions may help elucidate the processes of TIPS that contribute to higher science grades.

The analyses of the predictors of science report card grades also emphasize the importance of homework completion to science report card grades ($\beta = .46$, $p < .001$).

Analysis of variance (ANOVA) omnibus tests indicated significant differences in the homework return rates and average points earned by students in different class ability levels ($\underline{F}$ (2, 232) = 5.61, $\underline{p} < .005$; $\underline{F}$ (2, 232) = 12.45, $\underline{p} < .001$). Tukey HSD post-hoc analyses determined that low students (60.1%) turned in significantly fewer assignments than average (74.5%) or honors (76.7%) students, but average and honors did not differ significantly in their return rates. In terms of homework accuracy, all groups differed significantly from each other. Specifically, low students (4.5/10) earned the least average points; average students (6.0/10) earned significantly more points than low students but fewer points than honors; and honors (6.8/10) students earned significantly more points than average and low students.

Basically, these results indicate the fact that some students in all classes are not completing homework assignments. Contrast this study with Balli's (1995) investigation of 74 sixth grade students of the same family background completing 100% of their homework assignments.

The message here is clear; homework completion positively influences middle school student achievement. Teachers, parents, and students must understand the importance of students completing their homework assignments. When middle and high schools students do not spend the time they need to complete homework, they are at an academic disadvantage compared to students who do (Keith & Cool, 1992; Keith et al., 1993). Therefore, teachers and parents must encourage all students to complete their homework assignments in an effort to narrow achievement gaps by class ability groupings.

Results Often Differed Developmentally and by Gender

Interesting developmental and gender differences emerged in this study. Sixth grade students reported significantly higher family involvement levels and earned higher report card grades in science than eighth grade students, but eighth grade students returned more homework assignments. One might predict these developmental differences as sixth grade students just finished elementary school in which parental involvement in schoolwork is customary. Therefore, involving family members in homework assignments was not new for these students whereas for the eighth grade students it was. Similarly, as children grow, grading standards tend to become stricter which may account for sixth grade students earning higher report card grades.

Though males and females did not differ significantly in levels of family involvement in science or percent of homework assignments returned, male students earned significantly higher report card grades than females. The gender differences confirm results from previous studies alerting researchers to male advantages in math and science by high school (Hyde, Fennema, & Lamon, 1990; National Science Foundation, 1993), and sometimes by the time students reach middle school (Lee & Burkam, 1995). Continued longitudinal research on these interactive science activities, perhaps over the entire school year, may or may not uncover clues to reducing the gender gap in science achievement. Researchers should continue to investigate the factors that influence the gender difference to determine how changes in classroom teaching and practice as well as interactive homework assignments may possibly reduce inequalities in achievement across the genders.

Parent and Student Categories Provide New Insights into Achievement Results

This study explored the relationship between parent and student opinions and student opinions alone. Homework may be designed for many different purposes, but in the case of TIPS, homework is designed for interaction with a family partner. Given this purpose, it is important to investigate both student and family partner opinions of the interactive homework assignments.

Results indicate an interesting relationship. Students who rated the homework positively completed more homework. The matched student and parent patterns revealed an added bonus to those students whose parents also rated the homework enthusiastically. Again, these findings underscore the importance of reexamining homework practice and design. Teachers and parents must change their homework focus solely from time, to homework quality and interest.

Limitations

This study expanded current homework research in five important ways. This study 1) implemented a quasi-experimental design assigning half of the students to a non-interactive (ATIPS) homework condition and the other half to an interactive (TIPS) condition; 2) looked at the effects developmentally (sixth and eighth grade students); 3) examined results with different ability levels of students and different teachers; 4) collected various science achievement, family involvement, homework completion, and science attitude measures, and 5) examined a new homework subject area, science. Despite these strengths, future studies would benefit by examining the limitations of the present study.

Length of the Study

The first limitation relates to the length of the study period. Three studies of TIPS have been conducted: TIPS writing lasted one school year (Epstein et al., 1997); TIPS math lasted two months (Balli, 1995); and the current TIPS science study fell between the two with four months of observation. Some of the changes one might expect from a homework intervention like TIPS might include changes in parent and student attitudes about homework, changes in teachers' attitudes about homework and parental involvement, and achievement gains as a result of completing the homework on a regular basis. Two months and even four months is a short amount of time to expect a change in attitude or achievement gains. Monitoring the homework over an entire school year would permit analyses of results from last year to the current year. Obviously, the reason this is rarely done is due to the cost in terms of time for researchers and educators to coordinate the measures needed for such a comprehensive investigation.

Need for Standardized Achievement Scores

This study was also limited as standardized achievement tests in science were not available at the end of the study period. These scores are important as they are not influenced by individual teacher bias. Having these scores would permit researchers to determine whether TIPS students also experienced achievement gains as measured by standardized tests. If this proved true, one could conclude that the differences in TIPS and ATIPS report card grades were not solely due to teacher bias in favor of TIPS students. In this study, remember that the author assigned condition to entire classes of students. Some honors classes completed TIPS while other honors classes completed ATIPS. This assignment certainly invites less teacher bias than if condition were assigned by student. In this case, teachers might teach a class of both ATIPS and TIPS students in which bias would certainly come into play. Analysis of this question of teacher bias using standardized test scores does indeed warrant investigation to be sure this was not the sole cause of the TIPS achievement advantage.

Lack of Teacher Implementation Measures

Another study limitation relates to its lack of any specific measures of teacher implementation, namely homework introduction and follow-up. Though the author carefully instructed the teachers to keep introduction and follow-up of homework consistent in terms of *time* across condition, teachers varied in *how* that time was utilized. Introduction of the homework might include explaining the various questions and materials needed for the assignment, and for TIPS students only, pointing out the sections requiring family interaction. Follow-up includes grading (teachers graded each assignment on a 10-point scale) and teacher comments, review of homework answers in class, and talking with students and families about the importance of family involvement if home-to-school communications were not completed.

Teachers did vary in their comments to students (and even to parents) about errors and responses in the home-to-school communication section. For example, one of the sixth grade teachers took time to acknowledge all parent comments and reports by writing thoughtful responses to their messages on the homework assignment. For example, one parent noted the following: "These experiments are more fun to do than when I was in school, I may change careers." The teacher wrote the following statement in response: "I am glad to hear that both you and your child enjoy these assignments. I think they are fun myself!" One parent noted that the way a graph was presented seemed a bit confusing. The teacher acknowledged the comment and wrote: "Thanks for paying such close attention! I will change the assignment before I send it home next year." Such teacher feedback to parents and students could positively influence both parties' feelings about science homework and class.

Experimental studies of teacher feedback indicate that students of teachers who provide constructive written feedback on homework had higher achievement and more positive attitudes about the subject than students of teachers who did not provide such feedback (Cardelle & Corno, 1981; Elawar & Corno, 1985). An interesting study of feedback and interactive homework might examine the effects of variations in teacher feedback on both parent and student homework attitudes and how this relates to student achievement.

Because the author conducted no classroom observations of teacher instruction, there are no measures of possible teacher variation in implementation. Results revealed strong differences by teacher with respect to student achievement. Therefore, future studies must identify and investigate teacher differences in classroom homework introduction and follow up to see what characteristics, if any, promote or hinder student learning and likelihood of returning homework assignments.

Lack of Measures for the Quality of Homework Interaction

Another area of future study represents more detailed investigation of the use of TIPS assignments in the home. The matched parent and student survey questions permitted exploratory analyses of the student/parent interaction in both the TIPS and ATIPS conditions. Though both parents and students reported on their individual liking of the homework, no survey questions specifically addressed the content of or emotions about working together on homework. One may think of numerous questions worthy of exploration including the following: Was it enjoyable to work together? What was the role of the student in the interactive homework? What was the role of the parent in the assignment? Did the student feel the parent helped too much? Was there tension associated with working together? Future studies of family interaction on homework assignments should examine the findings from the few studies that have addressed the circumstances in which adolescents do homework and how these relate to academic performance (Leone & Richards, 1989; McDermott, Goldman, & Varenne, 1984; Patton, Stinard, & Routh, 1983).

Lack of Homework Adaptation by Class Ability Grouping

An important note to both researchers and educators relates to adaptation of the homework assignments to match the ability levels of students. In this study, all students completed the same homework assignments for the purpose of keeping content of assignments constant for all students in both conditions. Results indicated that students in the low ability classes earned significantly fewer homework points than average students. The sixth grade teachers who taught low ability students remarked that some of the homework assignments proved a bit too challenging for many of these students. Therefore, in practice, teachers should adapt homework assignments according to the ability levels of the students by either deleting some of the more challenging questions, providing more clues to an answer, or adding more challenging questions to promote critical thinking. Homework that is too challenging or too easy can frustrate or bore students rather than encourage learning and interest in a topic (Corno, 2000).

The Future of Homework

Numerous popular press books have been written to help parents survive the years of homework their children bring home (Cholden, Friedman, & Tiersky, 1998; Radencich & Shay Schumm, 1997). The titles indicate the frustration of both parents and students: 99 Ways to Get Your Kids to Do Their Homework (And Not Hate It), How to Do Homework Without Throwing Up, Ending the Homework Hassle : Understanding, Preventing, and Solving School Performance Problems, and Homework Without Tears : A Parent's Guide for Motivating Children to Do Homework and to Succeed in School .

Homework should never be assigned for the sake of homework. All homework should be designed with a clear purpose in mind. Epstein identified 10 common reasons for assigning homework: practice, preparation, participation, personal development, peer interactions, parent-child relations, parent-teacher communication, public relations, policy, and punishment (not a defensible purpose) (1998, 2000; Epstein & Van Voorhis, in press).

Results of this study show that well-designed TIPS homework assignments in science can help students practice skills, prepare for the next class, participate in learning activities, develop personal responsibility for homework, promote parent-child relations, develop parent-teacher communication, and fulfill policy directives from administrators. Survey reports from students indicated that students liked both the ATIPS and TIPS homework assignments, rated them better than standard homework, and suggested that they be used next year in school. Hundreds of prototype TIPS activities (including the science activities used in this study) in various subjects for middle and elementary grade students are available to teachers to use and adapt to their classroom objectives (Center on School, Family, and Community Partnerships, Baltimore, MD). In fact, researchers at Johns Hopkins are currently collecting the "top" TIPS activities developed by educators nationwide to share with schools in their efforts to improve homework practice.

Though the results of the TIPS program in science are positive, teachers should not abandon other types of homework. Again, homework designs serve different purposes, and independent homework still holds an important place on the educational agenda. Utilizing a variety of homework designs with clearly defined and different purposes would probably encourage more interest in the nightly ritual rather than promote boredom and frustration.

Continued research in this area requires strong connections and communications between researchers and educators. This particular study involved collaborations during the summer to design and produce the science homework assignments, and through the fall semester to monitor homework completion and collect various science achievement and attitude data. University and school partnerships allow researchers to share the findings of their work with educators who can use the results to improve teaching materials and practice. Teachers must have professional development opportunities that encourage them to reexamine their current homework practices to make improvements. Teachers already understand the importance of quality classroom instruction. Homework deserves the same level of attention as classwork, especially because homework enters a student's home life.

Learning does not take place in a vacuum and research must investigate the effects of educational interventions to understand who benefits and why. Three assumptions should guide continued investigations in the area of parental involvement in homework

(Renninger, 1999, p. 212): instructional decisions must be based on research of how students learn and develop; educators must be aware of developmental theory and research; researchers must become more familiar with educational practice to consider how their research may contribute more directly to educational practice.

Much of school homework today is monotonous, pointless, discouraging to students and parents, and disruptive of family time. Time must be allocated for teachers to learn more about the importance of homework to student achievement as well as strategies for developing meaningful homework assignments to match the creativity found in their classrooms. TIPS homework is one tool for teachers to use in their teaching repertoire to develop students' skills and to inform parents of what is going on in the classroom. The focus of homework must shift from an emphasis on homework time, to an emphasis on homework quality and homework design. As noted by one parent, " I think TIPS is great 3-way communication between teacher, parent, and student." Homework is here to stay, but brightening the future of homework will require a concerted effort on the part of teachers to reevaluate its varied purposes and design, emphasize its importance to students, and communicate to parents the roles they play in the homework process.

APPENDIX A
HOMEWORK ASSIGNMENT ORDER BY TEACHER

Table A-1. TIPS/ATIPS assignments over 18 weeks by teacher

Number	Teacher A (6)	Teacher B (6)	Teacher C (8)	Teacher D (8)
1	Cylinder	Cylinder	Journey to the core	Abiotic factors
2	Money puddles	Money puddles	Seismic waves	Niche
3	Out of control	Out of control	Plate tectonics	Food web
4	Metric system	Metric system	Stress	Energy pyramid
5	Float or sink	Float or sink	Stay or go	Fresh water
6	Density diver	Density Diver	Hardness	Oil and water
7	Egg	Egg	Erosion	Climatographs
8	Watershed	Watershed	It's the law	Population
9	Nutrients	Nutrients	Radioactive	Community
10	Careers	Pollution	Abiotic factors	Heredity
11	Pollution	Profile mapping	Niche	Pea plants
12	Profile mapping	Designer fish	Food web	Colorblind
13	Designer fish	Careers	Food pyramid	Designer fruit
14	Complex car conversions	Complex car conversions	Fresh water	Striving for perfection
15	Wasted energy	Wasted energy	Climatographs	Cloning
16	Levers	Levers	Oil and water	Same or different
17	Hard work	Design a bike	Population	Survival
18	Design a bike	Hard work	Community	Extinction

APPENDIX B
SAMPLE TIPS ACTIVITY

Name:______________________________Class:__________________Date:___________

Journey Through the Earth's Layers

Dear Parent or Guardian,

We are learning about the internal structure of the earth. This activity will help build science skills in observing, comparing, and evaluating a model. I hope you enjoy this activity with me. This assignment is due ____________.

Sincerely,

____

OBJECTIVE: To identify the four layers of the Earth.

MATERIALS: 1 food item that has layers such as a hard boiled egg, chocolate covered peanut, avocado, apple, or another item that has layers.

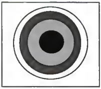
knife to cut the food item in half (STOP: Do not use the knife without your partner.)

PROCEDURE:

1. Read and explain the following definitions to your family partner.
   Who is your family partner?_____________

crust:	thin, outermost layer of earth
mantle:	layer of earth between the crust and outer core
outer core:	liquid layer of earth surrounding the inner core
inner core:	solid, innermost layer of earth

2. With your family partner, carefully cut your food item in half. Draw and label a cross section of your item in Box A. Your labels for the food item might include some of the following terms: shell, skin, pit, chocolate covering, yolk, etc. Next, label the diagram of the cross section of the earth in Box B with the vocabulary terms from above. (3 points)



BOX A **BOX B**

DATA CHART

Show your family partner the labels and drawings you worked on in Step 2. Discuss with your partner the similarities and differences between the diagrams in Boxes A and B. You should record the ideas from your discussion in the data chart below. (**2 points**)

Question	My ideas	My family partner's ideas
Similarity of diagram A and B		
Difference of diagram A and B		

CONCLUSIONS:

Write your answers in complete sentences.

1. Why are models/diagrams useful for studying the layers of the earth? (**1 point**)

____

2. What is one disadvantage of using a model or diagram to understand the layers of the earth? (**1 point**)

____

FAMILY DISCUSSION: (3 points)

The author Jules Verne wrote a book entitled "Journey to the Center of the Earth" about a young man's trip into the earth. Discuss with your family partner whether or not each of you would like to travel to the center of the earth? You record both responses below in complete sentences.

My answer:____

____

My family partner's answer:____

____

What would you expect the center of the earth to be like?______________________________

____

HOME-TO-SCHOOL COMMUNICATION:

Dear Parent or Guardian,

Please give me your reactions to your child's work on this activity.

Write YES or NO for each statement.

______1. My child understood the homework and was able to discuss it.

______2. My child and I enjoyed the activity.

______3. This assignment helped me know what my child is learning in science.

Any other comments: ____

Parent/Guardian Signature.____

Teachers Involve Parents in Schoolwork (TIPS) (1999) L. Bland, N Dewberry-Moore, F Van Voorhis, & J Epstein Baltimore MD Center on School, Family, and Community Partnerships, Johns Hopkins University

APPENDIX C
SAMPLE ATIPS ACTIVITY

Name:________________________________Class:________________Date:__________

Journey Through the Earth's Layers

This assignment is due ____________.

OBJECTIVE: To identify the four layers of the Earth.

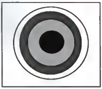
MATERIALS: 1 food item that has layers such as a hard boiled egg, chocolate covered peanut, avocado, apple, or another item that has layers.
knife to cut the food item in half

PROCEDURE:

1. Review the following definitions.
   Who is your family partner?____________

crust:	thin, outermost layer of earth
mantle:	layer of earth between the crust and outer core
outer core:	liquid layer of earth surrounding the inner core
inner core:	solid, innermost layer of earth

2. Carefully cut your food item in half. Draw and label a cross section of your item in Box A. Your labels for the food item might include some of the following terms: shell, skin, pit, chocolate covering, yolk, etc. Next, label the diagram of the cross section of the earth in Box **B** with the vocabulary terms from above. (3 points)



BOX A **BOX B**

DATA CHART

Label the drawings you worked on in Step 2. Think about the similarities and differences between the diagrams in Boxes A and B. Record your ideas in the data chart below. (**2 points**)

Question	My ideas
Similarity of diagram A and B	
Difference of diagram A and B	

CONCLUSIONS:
Write your answers in complete sentences.

1. Why are models/diagrams useful for studying the layers of the earth? (**1 point**)
2. What is one disadvantage of using a model or diagram to understand the layers of the earth? (**1 point**)

The author Jules Verne wrote a book entitled "Journey to the Center of the Earth" about a young man's trip into the earth. Think about whether or not you would like to travel to the center of the earth? Record your response below in complete sentences. (**3 points**)
My answer:

What would you expect the center of the earth to be like?

(1999). L. Blind, N. Dewberry-Moore, F. Van Voorhis, & J. Epstein Baltimore, MD. Center on School, Family, and Community Partnerships, Johns Hopkins University.

APPENDIX D
TIPS/ATIPS TEST QUESTIONS

Grade 6/ Skills And Processes

Cylinder Challenge

Choose the letter of the statement that **best** completes the statement.

1. A hypothesis is .....
   a. an educated guess.
   b. the solution to your problem.
   c. an educated guess as to the solution of your problem.
   d. a guess made to solve a problem.
2. If you worked for Pepsi and you wanted the consumer to "think" that they were getting more soda , would you choose to bottle your soda in a tall, thin container or a short, stout container? Justify your answer based on the results of the "Cylinder Challenge" homework experiment.

Money Puddles?

1. Jimmy conducts an experiment to determine how well a certain brand of popcorn pops. In his first trial, there were 10 kernels of popocorn left unpopped. In his second trial, there were 14 kernels left unpopped. In his last trial there were 6 kernels left unpopped. Choose the letter that corresponds to the **average number** of kernels left unpopped.
   a. 30
   b. 10
   c. 20
   d. none of the above
2. In the "Money Puddles" experiment, you conducted 3 trials for each coin. If real scientists were conducting this experiment, they might do 100 or more trials for each coin. Explain why in complete sentences.

Out of Control!

You want to find out which laundry detergent removes chocolate stains the best. To conduct this experiment, you applied equal amounts of Hershey's® chocolate to 3 equal-sized samples of the same type of cloth. You used the same amount of Tide®, Bold®, and Era® laundry detergents to wash the 3 samples of cloth. You washed the stained cloth samples in 3 different washing machines. You washed the Tide, Bold®, and Era® cloth samples in warm water.

1. Circle the variable from the following list that threatens the validity of your experiment.
   a. amount of chocolate used to stain
   b. type of cloth
   c. amount of laundry detergent
   d. type of washing machine
   e. size of cloth sample
   f. temperature of washing machine water
2. Why is it important in an experiment that you keep all of the variables the same EXCEPT for the one variable being tested? Be specific.

Metric Madness

1. Circle the **best** prefix/unit combination for the statement.
   The distance from Baltimore to Washington, DC
   a. Meters
   b. Centimeters
   c. Millimeters
   d. Kilometers
2. Mr. McChesney (teacher name) wants you to tell him how much water is in a swimming pool. Which metric unit of measurement should you use (grams, liters, meters, degrees Celsius)? Explain why this unit is appropriate.

Grade 6/ Oceanography

Float or Sink?

1. You have been given a sample of mystery substance "X." The mass of substance X is 57.75 grams, and its volume is 3.5 cm^3. Calculate the density of substance X using this formula Density = Mass ÷ Volume. Show your work (don't forget the units).
2. After making measurements, you calculate that the density of a substance is 0.5 g/cm^3. Will this substance float in water? Explain.

Density Diver

1. True or False: If you want a submarine to sink, you should fill the tank with more air than water.______________ Explain your answer.
2. Your friend has built a model of a ship. Before you sail it in a lake, you want to make sure that it will float. Calculate the **average density** of the following items found in your friend's ship: steel (2.5 g/cm^3), air (0.01 g/cm^3), plastic (0.9 g/cm^3), and clay (2.0 g/cm^3). The average density of the ship is ____________ g/cm^3 Based on the average density you calculated, will the ship float or sink in water?____________

Salinity ("Egg"cellent Experiment)

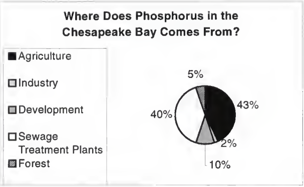
1. If an egg floats in saltwater, the density of the egg is ________________ the density of water.
   a. greater than
   b. less than
   c. equal to
2. The section of the Chesapeake Bay that has the highest salinity is….
   a. the southern portion where the Atlantic Ocean meets the Chesapeake Bay.
   b. the northern portion where the Susquehanna River meets the Chesapeake Bay.
   c. the western portion where the Potomac River meets the Chesapeake Bay.

Watershed: Where on Earth is the Chesapeake Bay?

1. All of the following are Chesapeake Bay watershed states EXCEPT…
   a. New York
   b. Maryland
   c. Illinois
   d. Delaware
   e. Pennsylvania
2. Why is it important for the six Chesapeake Bay watershed states to cooperate when it comes to prevention of water pollution?

Nutrients: Nutrient Enrichment-Too Much of a Good Thing

1. According to the chart below, the percent of phosphorus produced by agriculture **and** sewage treatment plants is….
   a. 40%.
   b. 43%.
   c. 95%.
   d. 83%.
   e. 3%.



a. How much phosphorus is produced naturally or from non man-made sources?
   a. 43%
   b. 40%
   c. 2%
   d. 5%

Pollution Solution

1. An over-fertilized lawn becomes or causes….
   a. toxic material.
   b. acid rain.
   c. nutrient enrichment.
2. Muddy water is most likely to be caused by …
   a. too much car exhaust.
   b. too much fertilizer being applied to a farm field.
   c. motor oil dumped in a storm drain.
   d. loose dirt at a construction site.

Profile Mapping the Ocean Floor

1. Underwater topographical features include all of the following EXCEPT….
   a. seamounts.
   b. continents.
   c. abyssal plains.
   d. guyots
2. Who do you think would find a profile of the map of the ocean floor more useful, a surfer or a fisherman? Explain your answer.

Designer Fish

1. What is the difference between a predator and its prey?
2. A powerful jaw is an adaptation of which of the following organisms:
   a. starfish
   b. killer whale
   c. flounder
   d. angelfish

Oceanography Careers

1. The famous oceanographer, Jacques Cousteau, did all of the following EXCEPT…
   a. find the Titanic.
   b. invent the aqualung (SCUBA gear).
   c. produce films.
   d. support conservation of wildlife and resources.

2. Describe one of the four fields of oceanography.

Grade 6/ Making Machines Work

Complex Conversions in a Car

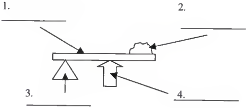
1. A lit match produces…
   a. heat energy.
   b. nuclear energy.
   c. electrical energy.
2. When a car battery dies….
   a. the car ran out of gas.
   b. the headlights will not work.
   c. the engine keeps running because you have plenty of gasoline.
   d. the radio will still work.

Wasted Energy

1. As the efficiency of a machine INCREASES, waste energy…
   a. increases.
   b. decreases.
   c. stays the same.
2. In an overhead projector, why is heat considered a form of waste energy? Explain.

Levers Have Class!

1. All of the following are examples of complex machines EXCEPT…
   a. a lever.
   b. a computer.
   c. a car.
   d. a lawnmower.
2. Label all of the parts of this 3rd class lever using the word bank below.
   -lever
   -effort
   -fulcrum
   -resistance (load)



Design a Bike

1. Give an example of one simple machine found in a bicycle.___________________
2. Mountain bikes need tires of _____________width to travel on hilly, rugged, unpaved trails.
   a. narrow
   b. medium
   c. wide

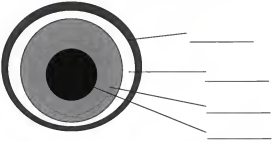
Work

1. All of the following are examples of physical work EXCEPT….
   a. mowing the lawn for 2 hours.
   b. shoveling the driveway twice in one day.
   c. washing and waxing a car.
   d. studying really hard for a test.
2. The unit used to measure **work** is the….
   a. meter.
   b. Newton.
   c. Newton-meter.

Grade 8/ Geology

Earth's Core

1. Label the 4 layers of the earth on the following diagram.



2. Compare two of the earth's layers. Write your answer in complete sentences.

Seismic Waves

1. What are seismic waves?

2. Which of the following instruments would be used to measure the strength of an earthquake?
   a. Richter Scale
   b. seismograph
   c. hardness scale
   d. none of the above

Earth's Surface

1. Differentiate between an anticline and syncline. Draw a diagram and label "A" for anticline and "S" for syncline.
2. Compare 3 types of stress.

Stay or Go? Earthquakes and Volcanoes

1. What is the difference between dormant and active volcanoes?
2. Which of the following terms is most closely associated with the San Andreas Fault?
   a. Ring of Fire Zone
   b. Mid-Atlantic Ridge
   c. Mediterranean Zone
   d. None of the above

Plate Tectonics

1. Describe the theory of plate tectonics.
2. When two plates are moving away from each other, they are _____________________.
   a. converging
   b. diverging
   c. sliding past
   d. static

Hardness Scale

1. List 2 properties used to describe rocks and or minerals.
2. List 2 items used to determine the hardness of a rock or mineral.

Erosion

1. Differentiate between erosion and deposition.
2. Which of the following would probably not be classified as a sediment?
   a. grain of sand
   b. pieces of shell
   c. bone fragments
   d. large boulder

Radioactive Dating

1. Describe what is meant by the half-life of a radioactive element.
2. If you start with 100 grams of a radioactive substance, how many grams will be left after two half-lives have passed?

Fossils

1. What are trace fossils?
2. What can trace fossils tell us about an organism?

Law of Superposition

1. Name the 4 geologic eras in order from longest ago to most recent.
2. Identify one organism that lived during each of the 4 geologic eras.

Grade8/ Ecology

Biotic and Abiotic Factors

1. Differentiate between biotic and abiotic factors. Give two examples of biotic and 2 examples of abiotic factors.
2. Classify the following items as either biotic or abiotic.
   a. water
   b. tree
   c. rocks
   d. mushroom
   e. zooplankton

Climatographs

1. List two particular characteristics that are necessary to identify a biome.
2. What units are used to measure average precipitation?
   a) degrees F
   b) inches
   c) liters
   d) grams

Niche

1. Describe a rabbit's niche.
2. Which of the following are included in an organism's niche?
   a. food
   b. reproduction
   c. living space
   d. all of the above

Food Webs

1. Explain how producers and consumers interact.
2. Explain why a food web is a better model than a food chain to illustrate feeding patterns in an ecosystem.

Energy Pyramid

1. Based on the information you know about the energy pyramid, which level contains the most organisms?
2. Explain why humans are top level consumers. Justify your answer.

The Water Cycle

1. Construct a diagram of the water cycle.
2. Describe the parts of the water cycle.

Oil Spill

1. Identify 2 causes of water pollution.
2. Describe the impact an oil spill can have on the environment.

Population Growth

1. What is meant by the term carrying capacity?
2. How have advances in medical technology or agriculture contributed to population growth?

Community Growth

1. Describe 2 ways human population growth has negatively affected the environment.
2. As a school community, what type of action plan could we reinforce in the cafeteria to reduce pollution.

Bath or Shower

1. Define conservation.
2. Identify 3 ways to conserve water.

Grade 8/ Genetics

Heredity

1. Name 2 dominant traits in the human population.
2. Explain heredity.

Tall or Short Pea Plants

1. Differentiate between the genotype of an organism and the phenotype of the organism.
2. If one parent's genotype is (Tt) and the other parent's genotype is (tt), what will the phenotypes of the parents be. Use a Punnett square to show the genotypes of the offspring.

Colorblindness

1. What does it mean to be a carrier of a sex-linked trait?
2. Would an individual with the genotype X^bY be colorblind? Explain why or why not.

Fruits and Vegetables

1. Describe the process of hybridization and give an example of a hybrid organism.
2. How can hybridization be beneficial in developing new fruits and vegetables.

Inbreeding

1. What is the difference between a purebred dog and a mixed breed?
2. Dalmations that are inbred often have problems with ___________.

Cloning

1. Describe the relationship between a clone and its parent.
2. Do you believe that there should be a law that prohibits the possibility of cloning humans? Justify your answer.

Variation

1. Describe 2 variations that occur in the human population.
2. If you want to conduct a fair test, which of the following groups should you use
   a) All the teachers in your school
   b) Twenty 8th grade girls
   c) Ten 6th graders and ten 8th graders
   d) Twenty people who live in your community

Natural Selection

1. Name 2 characteristics of an organism that may increase its chance of survival.
2. Pick an animal and describe an adaptation that allows it to be better suited to its environment.

Endangered Species

1. Differentiate between extinct and endangered species.
2. Explain why the development of major cities has caused many animals to become endangered.

APPENDIX E
STUDENT AND PARENT SURVEYS

STUDENT SURVEY OF SCIENCE HOMEWORK
GREEN SHEETS

#_____

To all students:

Please answer the following questions about your science homework. Answer all questions honestly. Your answers will help us plan for the future. Please answer ALL QUESTIONS thinking about your science homework from the beginning of the school year (September 1999) to now. Thank you very much for your help.

I. GREEN SCIENCE HOMEWORK ASSIGNMENTS (GREEN SHEETS)

1. How often did you work on homework in these subjects with a family partner at home? Circle ONE response for each question.

	NEVER	RARELY	SOMETIMES	FREQUENTLY	ALWAYS
a. LANGUAGE ARTS homework	Never	Rarely	Sometimes	Frequently	Always
b. MATH homework	Never	Rarely	Sometimes	Frequently	Always
c. SCIENCE Green Sheets	Never	Rarely	Sometimes	Frequently	Always

2. You were asked to complete 18 green science homework assignments (green sheets) since September, 1999.

a. About how many green sheets did you work on with a parent? (check one)

_____none of the 18 assignments
_____5 or fewer assignments
_____6-10 assignments
_____11-15 assignments
_____16-17 assignments
_____all 18 assignments

b. About how many green sheets did you work on with a parent? (check one)

_____none of the 18 assignments
_____5 or fewer assignments
_____6-10 assignments
_____11-15 assignments

_____16-17 assignments
_____all 18 assignments

c. About how many green sheets did you work on with **someone else at home (not a parent)**? (check one)
_____none of the 18 assignments
_____5 or fewer assignments
_____6-10 assignments
_____11-15 assignments
_____16-17 assignments
_____ all 18 assignments

d. Check the boxes next to **all** of the people who worked with you on **any** of the green sheets.
☐Mother ☐Father ☐Step-Mom ☐Step-Dad
☐Sister ☐Brother ☐Other relative or friend (describe)___________

e. Put a star ★ next to the person who worked with you most often on the green sheets.

f. I learned more when I worked on the green sheets… (check one)
☐ alone.
☐ with a partner.
☐ about the same alone as with a partner.

II. TIME ON HOMEWORK

Place an "X" next to the amount of time you usually spent on homework.

3. About how much time did you spend on homework for **all subjects** *in an average week*?
____0 minutes
____less than 30 minutes
____30 minutes to 1 hour
____1-2 hours
____2-3 hours
____3-4 hours
____more than 4 hours

4. About how much time did you spend on **science homework** ONLY *in an average week?*

_____0 minutes
_____less than 30 minutes
_____30 minutes to 1 hour
_____1-2 hours
_____more than 2 hours

5. About how much time did you spend on **a typical** green sheet?

_____0 minutes
_____less than 15 minutes
_____15-30 minutes
_____30-45 minutes
_____45 minutes- 1 hour
_____more than 1 hour

6. About how much time did a **parent or other family partner** spend with you on **a typical** green sheet?

_____0 min.
_____less than minutes
_____15-30minutes
_____30-45 minutes
_____45 minutes- 1 hour
_____more than 1 hour

III. YOUR OPINIONS

7. What do you think of the green science homework sheets? Do you AGREE A LOT, AGREE A LITTLE, DISAGREE A LITTLE, or DISAGREE A LOT with each statement? **(circle one on each line)**

	AGREE A LOT	AGREE A LITTLE	DISAGREE A LITTLE	DISAGREE A LOT
a. The green science sheets are a good idea.	Agree A Lot	Agree A Little	Disagree A Little	Disagree A Lot
b. My parent or family partner liked working on green sheets with me.	Agree A Lot	Agree A Little	Disagree A Little	Disagree A Lot
c. The green sheets take too much of my time.	Agree A Lot	Agree A Little	Disagree A Little	Disagree A Lot
d. The green sheets take too much of my parent or family partner's time.	Agree A Lot	Agree A Little	Disagree A Little	Disagree A Lot
e. The green sheets help my parent or family partner see what I am learning in science.	Agree A Lot	Agree A Little	Disagree A Little	Disagree A Lot
f. My parent or family partner needs more information from the school to do the green sheets with me.	Agree A Lot	Agree A Little	Disagree A Little	Disagree A Lot
g. My parent or family partner likes to hear what I am learning in school.	Agree A Lot	Agree A Little	Disagree A Little	Disagree A Lot
h. The green science sheets are better than regular homework.	Agree A Lot	Agree Little	Disagree A Little	Disagree A Lot

	AGREE A LOT	AGREE A LITTLE	DISAGREE A LITTLE	DISAGREE A LOT
i. Students in this school should use the green sheets next year.	Agree A Lot	Agree A Little	Disagree A Little	Disagree A Lot
j. I do not like to share my science work with someone at home.	Agree A Lot	Agree A Little	Disagree A Little	Disagree A Lot
k. I like science this year more than I did last year.	Agree A Lot	Agree A Little	Disagree A Little	Disagree A Lot
l. I am able to talk about my science work with a family partner.	Agree A Lot	Agree A Little	Disagree A Little	Disagree A Lot
m. I work as hard as I can in science.	Agree A Lot	Agree A Little	Disagree A Little	Disagree A Lot
n. I want to complete high school.	Agree A Lot	Agree A Little	Disagree A Little	Disagree A Lot
o. I want to go on to college.	Agree A Lot	Agree A Little	Disagree A Little	Disagree A Lot

IV. QUESTIONS ABOUT SCIENCE CLASS

Please check one answer for each of the following questions.

8. In my science class, I get so interested that I don't want to stop work on an assignment.
   _____1. Never
   _____2. Hardly ever.
   _____3. Quite often.
   _____4. Every day.

9. The work I do in science class is...
   _____1. Not at all important to me.
   _____2. A little important to me.
   _____3. Pretty important to me.
   _____4. Very important to me.

10. Work in science class is just busy work and a waste of time.
   _____1. Always.
   _____2. Often.
   _____3. Sometimes.
   _____4. Seldom.
   _____5. Never.

V. QUESTIONS ABOUT YOUR SCIENCE INTEREST

11. How interested are you in each of the following subjects. (circle one on each line)

Rate how interested you are in...	Very Interested	Interested	Sort of Interested	Neutral	Sort of Uninterested	Uninterested	Very Uninterested
Science	1	2	3	4	5	6	7
Math	1	2	3	4	5	6	7
English	1	2	3	4	5	6	7
Oceanography (the study of the oceans)	1	2	3	4	5	6	7
Mechines (the study of non-living instruments that make work easier)	1	2	3	4	5	6	7
Reproduction (the study of how offspring are produced)	1	2	3	4	5	6	7
Chemistry (the study of matter, atoms, end molecules)	1	2	3	4	5	6	7
Phyaical sciences (the study of energy and nonliving matter)	1	2	3	4	5	6	7
Life sciences (the study of living things)	1	2	3	4	5	6	7

VI. QUESTIONS ABOUT YOU

12 a. Are you....(check one)

____male
____female

b. How old are you? ___________years old

c. How many adults live in your home? ___________adults

d. How many children live in your home (**include yourself in the number**)? _________children

e. Which best describes you? (circle one)

African-American Asian-American Hispanic Multi-Racial White
Other (describe)____________

f. How far in school did your mother (or female guardian) go? (check one)
______Some high school, but did not graduate
______Graduated from high school
______Some college, but less than four years
______Graduated from a 4- year college
______Attended graduate or professional school after college
______Don't know

g. My mother (or female guardian) is...
______Employed full time.
______Employed part time.
______Not employed.
______Not sure.

h. My father (or male guardian) is...
______Employed full time.
______Employed part time.
______Not employed.
______Not sure.

VII. COMMENTS ABOUT HOMEWORK

13. Do you have any other comments or suggestions about the green science sheets?

14. Do you have any other comments or suggestions about homework in general?

Thank you for your help!

FAMILY SURVEY OF SCIENCE HOMEWORK
GREEN SCIENCE HOMEWORK ASSIGNMENTS (GREEN SHEETS)

#_____

Instructions to the student:
Please give this survey to your parent or guardian who helped you most often with the weekly green science homework sheets. Please return the completed survey to your science teacher by ________________ (Due Date).

Dear Parent or Guardian,

Please answer the following questions about your child's science homework (green sheets) from the beginning of the school year (September, 1999) until now. This will help us plan for the future. Thank you very much.

Who is filling out this survey? (check one)

☐Mother	☐Father	☐Step-Mom	☐Step-Dad
☐Grandmother	☐Grandfather	☐Other relative or friend (describe)_______	

I. GREEN SCIENCE HOMEWORK ASSIGNMENTS (GREEN SHEETS)

1. How often did you or another family partner work with your child at home on homework in these subjects? Circle ONE response for each question.

	NEVER	RARELY	SOMETIMES	FREQUENTLY	ALWAYS
a. LANGUAGE ARTS homework	Never	Rarely	Sometimes	Frequently	Always
b. MATH homework	Never	Rarely	Sometimes	Frequently	Always
c. SCIENCE Green Sheets	Never	Rarely	Sometimes	Frequently	Always

2. Your child had 18 green science homework sheets (green sheets) since September, 1999.
   a. On about how many green science homework sheets did your child work with a **parent**? (check one)
      _____none of the 18 assignments
      _____5 or fewer assignments
      _____6-10 assignments
      _____11-15 assignments
      _____16-17 assignments
      _____all 18 assignments

b. On about how many green science homework sheets did your child work with **someone else at home (not a parent)**? (check one)

_____none of the 18 assignments
_____5 or fewer assignments
_____6-10 assignments
_____11-15 assignments
_____16-17 assignments
_____all 18 assignments

II. YOUR OPINIONS

3. What do you think of the green science homework sheets? Do you AGREE A LOT, AGREE A LITTLE, DISAGREE A LITTLE, DISAGREE A LOT, or NOT SURE for each statement? **(circle one on each line)**

	AGREE A LOT	AGREE A LITTLE	DISAGREE A LITTLE	DISAGREE A LOT	NOT SURE
a. The green science sheets are a good idea.	Agree A Lot	Agree A Little	Disagree A Little	Disagree A Lot	Not Sure
b. I or another family partner liked working on green sheets with my child.	Agree A Lot	Agree A Little	Disagree A Little	Disagree A Lot	Not Sure
c. The green science sheets take too much of my child's time.	Agree A Lot	Agree A Little	Disagree A Little	Disagree A Lot	Not Sure
d. The green science homework sheets take too much of my or another family partner's time.	Agree A Lot	Agree A Little	Disagree A Little	Disagree A Lot	Not Sure
e. Green science homework sheets help me see what my child is learning in class.	Agree A Lot	Agree A Little	Disagree A Little	Disagree A Lot	Not Sure
f. I need more information from the school to do the green science sheets with my child.	Agree A Lot	Agree A Little	Disagree A Little	Disagree A Lot	Not Sure
g. I or another family partner likes to hear what my child is learning in school.	Agree A Lot	Agree A Little	Disagree A Little	Disagree A Lot	Not Sure
h. Students in this school should use the green science sheets next year.	Agree A Lot	Agree A Little	Disagree A Little	Disagree A Lot	Not Sure
i. My child does not like to share science work at home.	Agree A Lot	Agree A Little	Disagree A Little	Disagree A Lot	Not Sure
j. My child is able to talk about science work with me or another family partner.	Agree A Lot	Agree A Little	Disagree A Little	Disagree A Lot	Not Sure
k. My child works as hard as s/he can in science.	Agree A Lot	Agree A Little	Disagree A Little	Disagree A Lot	Not Sure
l. I want my child to complete high school	Agree A Lot	Agree A Little	Disagree A Little	Disagree A Lot	Not Sure
m. I want my child to go on to college.	Agree A Lot	Agree A Little	Disagree A Little	Disagree A Lot	Not Sure

IV. COMMENTS ABOUT HOMEWORK

8. Do you have any other comments or suggestions about the green science sheets?

9. Do you have any other comments or suggestions about homework in general?

Thank you for your help!

APPENDIX F
LETTERS TO PARENTS

ATIPS Letter

September 1, 1999

Dear Parent or Guardian:

I am pleased to welcome your child to 6th grade science class. As a new part of the curriculum, I will assign each student in the science class one homework assignment each week for the first two marking periods. Assignments will generally be handed out on Wednesdays and will be due the following Tuesday. These assignments will be printed on GREEN paper and will be two or three sides of a sheet of paper.

As with all homework, these assignments are linked to our school objectives, and they are your child's responsibility to complete. However, it is important for you to know that these will be assigned on a regular basis and are part of the student's science grade. Each assignment is worth 10 points, and point values for each question are indicated on each assignment. Information from these assignments will be tested on exams.

Please contact me if you have any questions about these assignments or science class in general. I look forward to working with your child in science this year!

Sincerely,

Ima Great Teacher
6th Grade Science Teacher

- -

(Please cut this section and send with your child to school)
I have read the above information for my child's 6th grade science homework assignments. (Please ask your child to bring this slip of paper to science class as soon as possible. Thank you!)

Parent Name (please print):________________________________
Parent Signature:________________________________Date:____/____/__

LETTER TO TIPS PARENTS

September 1, 1999

Dear Parent or Guardian:

I am pleased to welcome your child to 6th grade science class. As a new part of the curriculum, I will assign each student in the science class one homework assignment each week for the first two marking periods. Assignments will generally be handed out on Wednesdays and will be due the following Tuesday. These assignments will be printed on GREEN paper and will be two or three sides of a sheet of paper.

As with all homework, these assignments are linked to our school objectives, and they are your child's responsibility to complete. However, it is important for you to know that these will be assigned on a regular basis and are part of the student's science grade. Each assignment is worth 10 points, and point values for each question are indicated on each assignment. Information from these assignments will be tested on exams.

Sections of these assignments require that the student involve you (a family member) in a discussion, interview, or question. Certain activities require use of the stove, oven, or knives, but all such activities include notes to students and pictures of stop signs to get the attention of all involved.

I encourage you to be involved in these assignments when your child asks you to do so. You are not required to teach any information to your child in the sections requiring interaction, and I hope you find the interactions useful and informative. Each assignment includes a home-to-school communication section at the end for you to make comments to me about how useful you and your child found the assignments to be. Please also indicate whether or not you and your child enjoyed the assignment as I will use that information in thinking about future homework assignments.

Please contact me if you have any questions about these assignments or science class in general. I look forward to working with your child in science this year!

Sincerely,

Ima Great Teacher
6th Grade Science Teacher

(Please cut this section and send with your child to school
I have read the above information for my child's 6th grade science homework assignments. (Please ask your child to bring this slip of paper to science class as soon as possible. Thank you!)

Parent Name (please print):_______________________________
Parent Signature:_______________________________________ Date:____/____/_____

APPENDIX G
DESCRIPTIVE DATA FOR ALL STUDY VARIABLES

Table G-1. Descriptive data for control variables

Variable Name	Data Source	Variable Range	Descriptives	Number ($\underline{N}$)
Previous science achievement	Report card grade	4-A 3-B 2-C 1-D 0-F	2.77 = $\underline{M}$ 0.95 = $\underline{SD}$ 20.5%- A 49.0%- B 20.5%- C 07.5%- D 02.5%- E	239
Mother education level	Student survey	0-don't know 1-high school 2-hs graduate 3-college 4-college grad 5-grad school	2.96 = $\underline{M}$ 1.70 = $\underline{SD}$ 03.6%- 0 12.5%- 1 16.5%- 2 31.7%- 3 18.3%- 4 17.4%- 5	224
Ability group	Rosters	0-low 1-average 2-honors	1.33 = $\underline{M}$ 0.71 = $\underline{SD}$ 14.6%- 0 38.7%- 1 46.6%- 2	253
Race	Student survey (12e)	1-African-American 2-Asian-American 3-Hispanic 4-Multi-Racial 5-White 6-Other	3.48 = $\underline{M}$ 1.94 = $\underline{SD}$ 35.9%- 1 01.8%- 2 00.9%- 3 04.9%- 4 52.5%- 5 04.0%- 6	223
Previous English	Research Office	Percentile	56.78= $\underline{M}$ 26.40= $\underline{SD}$	190
Previous math	Research Office	Percentile	55.99= $\underline{M}$ 27.74= $\underline{SD}$	189
Lunch status	Research Office	0-no f/r 1-f/r	75.3%-0 24.7%-1	231

Table G-2. Descriptive data for independent variables of interest

Variable Name	Data Source	Variable Range	Descriptives	Number (N)
Gender	Rosters	male & female	52.2%-male 47.8%-female	253
Grade	Rosters	6th and 8th	56.5%-6th 43.5%-8th	253
Condition	Rosters	TIPS and ATIPS	43.1%-ATIPS 56.9%-TIPS	253
Teacher	Rosters	1-Teacher A 2-Teacher B 3-Teacher C 4-Teacher D	25.7%-1 30.8%-2 21.7%-3 21.7%-4	253 65-1 78-2 55-3 55-4

Table G-3. Descriptive data for homework data (dependent variable)

Variable Name	Data Source	Variable Range	Descriptives	Number (N)
Percent of assignments returned	Homework	05.56-100%	73.61%=M 25.11%=SD	233
Percent of assignments completed	Homework	05.56-100%	71.50%=M 25.58%=SD	233
Percent of assignments returned late	Homework	0-44.4%	05.38%=M 08.53%=SD	233
Average points per assignment	Homework	.56-10	6.21=M 2.46=SD	233
Average percent family points	Homework	4.55-100%	63.47%=M 25.28%=SD	233

Table G-4. Descriptive data for TIPS assignments (dependent variable)

Variable Name	Data Source	Variable Range	Descriptives	Number (N)
Percent of assignments completed with a partner	Homework	0-100%	63.74%=M 30.05%=SD	131
Number of assignments child understood	Home-to-School Communication Section	0-18 (Yes)	9.21=M 5.57=SD	132
		0-05 (No)	0.14=M 0.55=SD	132
		0-18 (Missing)	8.44=M 5.43=SD	132
Number of assignments child enjoyed	Home-to-School Communication Section	0-18 (Yes)	8.36=M 5.48=SD	132
		0-15 (No)	0.83=M 2.19=SD	132
		0-18 (Missing)	8.59=M 5.61=SD	132
Number of assignments that helped parent know what is learned in class	Home-to-School Communication Section	0-18 (Yes)	9.11=M 5.61=SD	132
		0-05 (No)	0.11=M 0.56=SD	132
		0-18 (Missing)	8.58=M 5.53=SD	132
Percent of assignments signed	Home-to-School Communication Section	0-100%	53.82%=M 32.13%=SD	132

Table G-5. Descriptive data for science achievement (dependent variable)

Variable Name	Data Source	Variable Range	Descriptives	Number (N)
Percent of TIPS/ATIPS test questions correct	Class science tests	20.04-100%	75.65%=M 14.97%=SD	237
Average science test score with TIPS/ATIPS	Class science tests	36.25-100%	77.41%=M 12.30%=SD	240
Report card grade in science	Teacher grade book	0-F 1-D 2-C 3-B 4-F	2.67=M 1.07=SD	240

Table G-6. Descriptive data for interest in school subjects (dependent variable)

Variable Name	Data Source	Variable Range	Descriptives	Number (N)
Interest in science	Student survey (11a)	7- v interested 6- interested 5- some interest 4- neutral 3- some dintere 2- disinterested 1- v disinterest (1-7)	5.65=M 1.39=SD 32.6%-7 32.6%-6 15.6%-5 10.7%-4 04.5%-3 03.1%-2 00.9%-1	224
Interest in science class	Student survey (8-10)	I get so interested (0-3)	1.45=M 0.81=SD	225
		Science work is (0-3)	2.18=M 0.79=SD	218
		Science is busy (1-4) (Higher number more positive)	3.84=M 1.04=SD	223
Liking of science class	Student survey (7k) "Like more than last year"	1-disagree lot 2-disagree 3-agree 4-agree lot	2.80=M 1.13=SD	227
Interest in math	Student survey (11b)	7-v interested 1-uninterested (1-7)	5.35=M 1.92=SD	224
Interest in language arts	Student survey (11c)	7-v interested 1-uninterested (1-7)	5.14=M 1.70=SD	222
Student wants to complete high school	Student survey (7n)	1-disagree lot 4-agree lot	3.92=M 0.37=SD	227
	Family survey (3l)		4.00=M 0.00=SD	183
Student wants to go to college	Student survey (7o)	1-disagree lot 4-agree lot	3.89=M 0.43=SD	226
	Family survey (3m)		4.00=M 0.00=SD	183

Table G-7. Descriptive data for family involvement in homework (dependent variable)

Variable Name	Data Source	Variable Range	Descriptives	Number (N)
Family	Student survey	0-never	2.07=M	226
involvement	(1c, 2a, 2b)	1-rarely	1.31=SD	
in science		2-sometimes		
homework		3-frequently		
	How many did	4-always	2.19=M	226
	you work on		1.59=SD	
	with a parent?	0-none		
		1-5 or less		
	How many did	2-6-10	0.73=M	226
	you work on	3-11-15	1.04=SD	
	with someone	4-16-17		
	else at home?	5-all 18		
	Family survey	0-never	2.34=M	179
	(1c, 2a, 2b)	1-rarely	1.23=SD	
		2-sometimes		
		3-frequently		
	How many did	4-always	2.24=M	181
	your child work		1.61=SD	
	on with a	0-none		
	parent?	1-5 or less		
		2-6-10	0.67=M	180
	How many did	3-11-15	0.91=SD	
	your child work	4-16-17		
	on with	5-all 18		
	someone else at			
	home?			
Family	Student survey	0-never	1.53=M	226
involvement	(1b)	1-rarely	1.25=SD	
in math		2-sometimes		
homework		3-frequently		
	Family survey	4-always	1.65=M	179
	(1b)		1.15=SD	
Family	Student survey	0-never	1.12=M	226
involvement	(1a)	1-rarely	1.11=SD	
in English		2-sometimes		
homework		3-frequently		
	Family survey	4-always	1.49=M	179
	(1a)		1.15=SD	

Table G-8. Descriptive data for time on homework (dependent variable)

Variable Name	Data Source	Variable Range	Descriptives	Number (N)
All homework	Student survey (3)	0-no time 1-<30 min. 2-30min-1hr. 3-1-2 hours	3.20=M 1.53=SD	226
	Family survey (4)	4-2-3 hours 5-3-4 hours 6->4 hours not sure (family)	4.40=M 1.60=SD	177
Science homework	Student survey (4)	0-no time 1-<30 min. 2-30min-1hr. 3-1-2 hours	1.65=M 0.75=SD	225
	Family survey (5)	4->2 hours not sure (family)	2.10=M 0.92=SD	174
Typical green sheet	Student survey (5)	0-no time 1-<15 min. 2-15-30 min. 3-30-45 min.	1.89=M 0.79=SD	223
	Family survey (6)	4-45 min-1 hr. 5->1 hr. not sure (family)	2.31=M 0.92=SD	174
Family partner time on green sheet	Student survey (6)	0-no time 1-<15 min. 2-15-30 min. 3-30-45 min.	1.79=M 0.99=SD	224
	Family survey (7)	4-45 min-1 hr. 5->1 hr. not sure (family)	1.84=M 1.01=SD	177

Table G-9. Descriptive data for opinions of green sheets (dependent variable)

Variable Name	Data Source	Variable Range	Descriptives	Number (N)
Green sheets good	Student survey (7a)	1-disagree lot 4-agree a lot	3.13=M 0.88=SD	227
	Family survey (3a)		3.39=M 1.07=SD	180
Family partner liked working on them	Student survey (7b)	1-disagree lot 4-agree a lot	2.81=M 0.92=SD	227
	Family survey (3b)		3.14=M 1.04=SD	179
Green sheets take too much student time.	Student survey (7c)	1-agree a lot 4-disagree a lot	2.88=M 1.00=SD	226
	Family survey (3c)	(Higher number more positive)	3.17=M 1.16=SD	178
Green sheets take too much family time.	Student survey (7d)	1-agree a lot 4-disagree a lot	2.96=M 1.01=SD	225
	Family survey (3d)	(Higher number more positive)	3.26=M 1.08=SD	178
Green sheets help parent see what is learned	Student survey (7e)	1-disagree a lot 4-agree a lot	3.42=M 0.85=SD	226
	Family survey (3e)		3.52=M 0.91=SD	179
Parent needs more information from school.	Student survey (7f)	1-agree a lot 4-disagree a lot	3.12=M 0.99=SD	225
	Family survey (3f)	(Higher number more positive)	2.85=M 1.23=SD	181
Parent likes to hear what student is learning.	Student survey (7g)	1-disagree a lot 4-agree a lot	3.42=M 0.73=SD	225
	Family survey (3g)		3.89=M 0.65=SD	182

Table G-9--continued.

Variable Name	Data Source	Variable Range	Descriptives	Number (N)
Green sheets are better than regular homework	Student survey (7h)	1-disagree lot 4-agree a lot	3.13=M 1.04=SD	225
Students should use these next year.	Student survey (7i)	1-disagree lot 4-agree a lot	3.10=M 1.04=SD	227
	Family survey (3h)		3.22=M 1.24=SD	180
Student does not like to share science work.	Student survey (7j)	1-agree a lot 4-disagree a lot	2.92=M 1.01=SD	225
	Family survey (3h)	(Higher number more positive)	2.97=M 1.24=SD	181
Student can talk about science with family.	Student survey (7l)	1-disagree a lot 4-agree a lot	3.20=M 0.90=SD	226
	Family survey (3j)		3.55=M 0.80=SD	181
Student works as hard as s/he can in science.	Student survey (7m)	1-disagree a lot 4-agree a lot	3.38=M 0.75=SD	225
	Family survey (3k)		3.19=M 1.11=SD	182

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BIOGRAPHICAL SKETCH

Frances Landis Van Voorhis was born in Palm Beach Gardens, Florida and grew up in Tequesta, Florida with her parents, Ken and Carolyn Landis, and two sisters, Johanna and Gywneth Landis. She received her bachelor's degree in psychology from the University of Florida in 1995. She received both her master's and doctorate degrees from the graduate program in developmental psychology at the University of Florida under the supervision of Dr. Shari Ellis and Dr. Scott Miller (1997, 2000). Though fearful of the snow, she and her husband Kerry left the Sunshine State and the Gators for Maryland. She works for Dr. Joyce Epstein at the Center for School, Family, and Community Partnerships at Johns Hopkins University. Frances plans to use her knowledge of psychology and sociology research in education to open a K-12 charter school. She hopes that students at the school will find the joy in learning that she has found through her studies with many exemplary teachers!

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a thesis for the degree of Doctor of Philosophy.

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